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AND
AGRICULTURE.

No. LXXIII. SECOND SERIES. June 1808.

*Specification of the Patent granted to SAMUEL WILLIAMS,
of Finsbury Square, in the City of London, Merchant,
for an Invention, communicated to him by a Foreigner
residing abroad, of new and improved Machines and
Machinery for preparing and spinning Wool, Cotton,
Hemp, and other filamentous Substances.*

Dated April 8, 1807.

With Plates.

TO all to whom these presents shall come, &c.
Now KNOW YE, that in compliance with the said proviso,
I the said Samuel Williams do hereby declare that my
said invention consists in and is founded on principles
hitherto unemployed in these arts, and so different from
the methods now in use, that to describe it will be to
distinguish it fully from those methods.

It is well known that when a cylinder rolls on a plane,
every point in the circumference of that cylinder de-

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B

scribes

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scribes a curve called a cycloid; and that if a cone turns on its axis, while the latter gyrates round a given centre coinciding with the summit of the cone, then every point in the circumference of the cone will describe a spherical cycloid; and in fine, that if a cylinder of a smaller diameter revolves round its axis, and rolls within a hollow cylinder of a larger diameter, then every point of the smaller cylinder will describe an epicycloid within the larger cylinder. On this principle then is founded the first branch of the invention. The surfaces of the contiguous bodies are to be furnished with a great number of hooks or card wires adapted to this kind of motion; and every time they meet, if there is wool between them, the hooks of both surfaces will seize each one-half of the whole, and divide it each time that such contact takes place, so that after a certain number of turns the wool will be fully opened and prepared for the further operations preparatory to spinning.

A little observation will lead to the reflection that if while a smaller cylinder rolls on a plane, a larger fixed to it be considered with respect to its surface, any point in the latter surface will describe a curve of the nature of the cycloid, but forming a loop so as to move backward for a moment, while the common centre of the two cylinders is moving forward. For example, if in Fig. 8, (Pl. I.) the cylinder *a* roll on the plane *bc*, every point in the circumference of the cylinder *dd*, will describe a looped curve *efg* as before stated. A new system of opening or carding filamentous substances is founded then on the general principle of cycloidal and epicycloidal motions, so modified as to rub to any degree by the relative diameter of the gyrating cylinder compared with that of the wheel which gives it motion.

To

To give this idea a more practical form, let *a b* Fig. 1, be a plane, on which the cylinder *c* rolls. It is there plain that every point of *c* describes a cycloid; but if the two surfaces of *a b*, and *c* be furnished, as in Fig. 2, with hooks or card-wires, then a mass of woolly substance *d*, will be pierced by every wire in each surface, and forcibly opened every time the cylinder *c* passes over it. And if instead of a long plane *a b*, a circular one be adopted, as in Fig. 3, and in lieu of cylinders a cone *a* be employed, then this repetition of effect will take place every time the axis of the cone gyrates round the centre of the plane: and thus the *hairy substance* though placed on one region only of the latter, will be soon divided and equally distributed on the whole surface of both the cone and the plane. If, further, *two* or more cones *b c*, Figs. 3 and 4, be used, rubbing against each other, while they roll on the plane (the latter being circular or conical as may be preferred), then will they perform at the same time the double operation of *opening and transposing* the substance by the cycloidal action, and of *carding* it by friction as in the common methods.

But the most useful form of this invention is perhaps that represented in Fig. 5, where *a b* is a large hollow cylinder furnished with hooks as before stated. In this cylinder, and on a crank or eccentric axis *c*, turns and gyrates the lesser cylinder *d*, bearing teeth similar to the former. A fixed toothed wheel placed at one end of the larger cylinder *a b*, and of a diameter equal to it, working in another wheel equal to the smaller cylinder *d*, and fixed to its axis, causes the latter to revolve as often as it would do by merely rolling on the surface of the larger cylinder: thus *insuring* the epicycloidal motion above referred to. If then the feeding cylinder *e*,

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by a motion properly combined, bring wool into contact with the gyrating cylinder *d*, a part of such wool will be taken at every gyration, and carried *across* the larger cylinder to some point *b* or *f*, according to the ratio that may exist between the diameter of the greater and the lesser cylinder; which ratio must be varied as the texture of the wool and other circumstance may require. In the same figure *g* represents a *receiving* cylinder (so called, because it receives the wool from the gyrating cylinder), which by a slow motion in the direction 1, 2 *g* conducts the opened wool up to *g*, whence it is discharged by methods similar to those used in common mechanical carding.

Fig. 6 contains a repetition of the same system, but with some extension. Here the wheel *d* fixed to the axis of the small cylinder is considerably smaller than its diameter; and of course as this gyrates (its wheel taking into that *ef*), any point in the circumference of the small cylinder moves *backward* for a moment while its axis moves forward, on the principle developed in Fig. 8. This being the case, wool lying on the surface *ab* will be both carded by the *friction* of the surface, and transposed from region to region of the great cylinder, as in the former example. One thing remains to be observed, which is, that as in order to add the carding principle to the transposing one, the ratio of the diameter of the wheels *d* and *ef* is *considerably* increased, and *might* thus cause the machine to *card* more than is desirable, the wheel *ef* is placed in a concentric position between the cocks 1, 2, 3, 4, but so as to recede from the pressure of *d*, and *only* turn it, in as much as *ef* shall be *bridled* by a factitious resistance applied to it depending on the will,

will, and to be determined by the strength of the staple submitted to the operation.

Fig. 7 represents a still further extension of the principle, or rather a combination of it with another new and useful property. In order to secure the perfect *feeding and equal issue* of the opened staple, the outer cylinder is composed of a *chain of staves* moving in a circular groove in each cheek of the frame furnished with hooks as before. This *chain* by a slow motion in the direction 1 2, brings the wool into contact with the gyrating cylinder, keeps it there as long as is necessary, and then carries it out at 3, to be *combed* off at 4 in the usual manner. Fig. 9 represents the manner of forming this chain of staves by the hinges 1, 2, 3, 4, &c.; *a b* is a longitudinal section of one of them to shew the tenons which fit into the circular groove above-mentioned.

Another principle which is employed for *carding*, and which it is intended should be considered as one of the grounds of this Patent, is that of a series of revolving cylinders, whose touching surfaces move *the same way*, but have each a swifter motion than its predecessor: so that if the cylinder *a*, Fig. 10, go round once *per second*, *b* should revolve one and a half or twice in the same time; *c* two or three times, &c. according to the progression that may have been adopted. By this system the surface on which it is chosen to lay a given quantity of woolly matter is enlarged indefinitely, and the woolly matter thus *opened* so completely that, if desired, no two hairs shall touch each other: and by adding another series of cylinders *e f g h*, with motions progressively slower, the same wool can then be again collected into as small a compass as may be required for the purpose of forming it into a ribbon or large thread; and thus it may

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may be prepared in the most homogeneous manner for spinning. And here it may be observed, that in this system all the card wires are not used as *hooks*, but (if there be no cards with *perpendicular wires*, which are preferable, and which it is intended making under this patent), a perpendicular effect is obtained by placing on some of the cylinders common cards in a cross-wise direction, whose wires are thus upright if considered with respect to the line of their motion, and as they act both before and behind (according as the cards of a given cylinder act on those of its predecessor, or are acted on by those of its follower), the wool is in reality carded both backward and forward (as in common *hand carding*); whereas the common *mechanical* card only acts in one direction, and thus never *turns* the wool, nor then *fully* cards it. It remains only to say that after the operation is performed with these perpendicular cards, a certain number of cylinders are employed with *hooked* cards as at *h*, to receive the work of *these*, and to *deliver* it on the usual principle. As to the motions of these cards, whether in the increasing or decreasing series, they are produced, as in all similar cases, by proportionate wheels acting from one to the other; or by a lever or chain common to all, as convenience may suggest.

In Fig. 11 is represented the form preferred for the *upright card wires*, in order that besides the steadiness they acquire by passing through the card leather, they may have a basis of their own. This basis is a triangle formed by an horizontal bend *a*, and the two portions of wire *d e*, that precede the bends *b c*, which turn up the wire, and form the card-tooth, properly speaking; *f* is the plan of this tooth; *g* a view or elevation of it from a point opposite the first-mentioned angle; and *a b c* a per-

perspective view. By examining the plan *f*, and comparing it with Fig. 12, it is evident that these wires can be set *very* close to each other, without any of them riding over each other behind the leather. The principal reasons for preferring these wires are, that they can be made with less materials and greater ease than the common card wire; be placed with much greater exactness with regard to the carding surface; and that they can act both behind and before as the system of carding, represented in Fig. 10, requires.

An essential thing in the use of cards is to be able to place them on the cylinders, so as that no interval may exist between them; and of course without nails. This may be done in the following manner: the plates of cards *c d* are placed (*entirely* filled with wires) rather obliquely across the cylinders, and each end of the leather is fixed to a metallic *tightener a b* (see Fig. 13) turning upon the axis of the cylinder: and to *this* is fixed a ratchet-wheel *e*, into which falls the catch *f*, fixed to the tightener. The cards being all screwed to the latter, it is forced *round* either by a lever acting on the teeth of the ratchet or an endless screw. But, whatever be the *means*, this operation stretches excessively the card leathers; and as by the obliquity of their position, these are placed on a convex surface with respect to the line of traction, the basis of the card-wires are strongly pressed against the surface of the cylinder, and acquire the necessary stability without the use of nail or screw on any part of the cylindrical surface. As every increase of obliquity in the position of the card plates leaves the less room between them, the action of the tightener will evidently *crowd* them together if they
are

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are tolerably well placed, previous to its operation. If the card cylinders be long, a *tightener* is used at both ends.

Now with respect to *spinning* the above substances, the principle of it is founded in giving to the thread a twisting motion, not only as is usual at either end of it, but at some intermediate point *between these ends*: which is in fact to twist one end of the thread and untwist the other. This idea is embodied in its most simple form in Fig. 14; where the two pinchers *a b* hold the thread *c d*, but without motion; while those *e* being turned round the thread, untwist the part *f* of the thread, and increase the twist of the other part *g*. Now it is evident that the untwisted part is weakened or rendered *extensible*, while the other part holds so much the stronger together as it is the more twisted. In any machine then possessing the *drawing* properties, if a thread passes from cylinders having a given motion to others moving faster, and is *almost* untwisted as it goes, it will give way in the untwisted part, and lengthen in proportion to the drawing tendency.

To perform then this untwisting operation a ring *a* is used, see Fig. 15, 16, and 17, running on two grooved cylinders *b c* (or mounted in any other way, so as that the axis of its motion may coincide with that of the thread); the said ring *a*, carrying two forks *e e*; and those bearing, on screw points, two light cylinders *i k*, pressed against each other by a small spring *n n n* placed at the opposite ends of the forks. By these cylinders the thread is held fast with respect to its circular motions; and if *a* revolve, it is turned round its axis, being twisted at one end, and untwisted at the other as above mentioned. But this is so ordered, that the *twisted* part
is

Hemp, and other filamentous Substances.

is always contiguous to the *drawing* cylinders as at *o*, Fig. 16.

Thus then if a thread more or less twisted come from *p*; pass through the *feeding* cylinders *r*; the *decomposer* *a* (having the required velocity), and also through the *drawing* cylinders *s* to the bobbin *t*; the thread will be untwisted, drawn out and *re-twisted* as it passes, and be wound up on the bobbin as much longer and finer than before, as the velocity of the *drawing* cylinders shall have been greater than the *feeding* ones. It is almost needless to add that these motions are given by the wheels *A B*, and the pinions *D E*, working into the wheels *F G*, whose number and diameters are in the ratio required by the fineness of the thread, and the degree of twist existing or sought for. It may be proper to observe that the method described is not the only one for performing this *untwisting* operation. Among many others, the method shewn in Fig. 18, is selected as an example. It is nothing more than three pulleys *a b c*, with or without grooves, placed in the untwisting ring *d*, over which the thread passes as at 1 2 3, and by the friction of which the operation is performed as before. It is scarcely necessary to add that any method, fit to turn the thread round its axis without obstructing its longitudinal motion, may be usefully employed for the same purpose: this truth is self-evident.

It remains now to describe the new system for this operation of *drawing*: it consists in performing this operation by the sole friction of the thread round the *drawing* surfaces, and without that pressure of cylinders which constitutes the usual system. The bodies employed for this purpose are at a small distance from each other, and the thread receives its motion by clinging to their

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unpolished surfaces. In Figs. 16 and 17, this operation of drawing by friction is performed by a number of cylinders 1, 2, 3, 4, 5, placed so as to *bend* the thread as much as possible; and all having a motion very nearly equal. The thread in passing round them, and being tightened by the counter pull of the bobbins *p* and *t*, lays hold of the surfaces both of the feeding and drawing cylinders, and receives their motion respectively. And although this is one method, and a good one of *drawing by friction*, there are many others which it is needless to describe; one other method is however added in Fig. 18, where *a b* are two cylinders having both the same motion, placed near but rather obliquely to each other, so that the thread 1, 2, 3, passing from one round the other may not tend to ride upon itself. It is evident that the thread passing two or three times round these cylinders will cling to their surface as before-mentioned, and take the motion *they* may have received from the rest of the machine.

This subject is finished by remarking that, for simplicity, a single system of simultaneous untwisting and drawing has been supposed; but that those systems may follow each other to any number, and in any proportion of velocity, so as to draw down *at one passage* the largest thread to the smallest size required.

Fig. 19 is the *plan* of a new kind of chain, calculated to communicate motion from one wheel or machine to another in an uniform manner. The several articulations of this chain as *a a, b*, are made in the form of a chevron in blazonry, or like a pair of compasses open, and they are intended to *take* in wheels of which the teeth are formed in like manner. Thus before one link or tooth has ceased to act, the next is already acting; and for

for this reason there is no interval or inequality of motion. *d d d d* are the *places* of some of the centre pins round which the joints turn to permit the bending of the chain.

Fig. 20, is the plan of a chain possessed of the same properties, but with *solid* links, the chevrons being fixed or cast in relief upon them. These chains are useful in a great number of cases of general machinery, and especially in the communication of equable motion for the operations of preparing and spinning divers filaments.

Fig. 21, offers an useful improvement on spinning machines, arising out of the untwisting system. It is intended to avoid the necessity of always using spindles, and to *reel* the thread as it is spun. The parts *a b* are the drawers, and *c* the untwister. *d d*, *e e*, are light reels, one for giving, the other for taking the thread. (Or the thread may be taken from a bobbin with or without a twisting motion, and given to the reel, and *vice versa*, from the reel to the bobbin.) To use this system as here drawn, provide a skain of thread of a certain *number* or fineness, but twisted *more* than enough for that number. Then by passing that skain through this system it will be drawn from the reel *d d* by *a*, untwisted by *c*, lengthened by the difference of the motion of *a* and *b*; and in fine wound on the reel *e e* in a state for sale; where note, that the latter reel must have a tendency to envelope all the thread given by the drawer, but not *strong* enough to break it: this can easily be obtained by friction. And note also, that the reels may be single instead of double, as represented at *f g*.

In Fig. 22 is shewn the kind of teeth employed for the movements of the wheels, by which the use of cords or strings is avoided in the machinery. The teeth are

essentially oblique or of a *screw form* (but without its functions), and that whether made as chevrons, or single as in the wheels *qr* of this figure. The principal desideratum is, that the extent of the obliquity be as great or greater than the distance between two contiguous teeth. The axis of two wheels thus working (if it be intended to save all the friction) must also be in the same plane, for it is not understood that a wheel with oblique teeth, fit for an endless screw, and in which by accident another wheel works, or that a wheel whose teeth are oblique that those of another wheel situated *on another plane* may work into them, makes any part of this invention. In this instance the obliquity is intended to do away the friction and *inequality of action* that exists in common wheelwork. As to the section of these teeth it is subject to the same laws as that of common teeth; and such is their remarkable properties, that if they wear at all they will give each other the epicycloidal form (*i. e.* to *that part* of the tooth, that exceeds the calculated diameter); but when that and the division are become perfect by wearing, they will then (supposing the matter hard and the resistance moderated) cease to wear, and last without oil almost for ever. It may be observed also, that the same principle applies likewise to *bevel-wheels*; and that while, in cylindrical ones, the teeth are threads of a screw of which the functions are suppressed, so in the bevel ones, they are solid helica, increasing in dimensions and distance as they fold obliquely round the surface of a cone.

Having mentioned in the former part of this specification, a machine which twists and draws at the same time, it may be as well now to describe it under one of its forms, for it admits of many.

In

In Fig. 23, (Pl. II.) A B, are the sections of two toothed wheels connected with the two tubes *a a* and *b*, the latter turning in the former, and the outside one turning in a proper collar. The wheel A is connected with the tube *b*, at the other end of which is fixed the bevel wheel *c c*, which therefore occupies the *inside* of the said wheel B. To the large tube, and at its opposite end, is fixed the second wheel *d d*, which therefore is placed *without* the wheel A. In the hollow of each wheel is placed a small piece of drawing machinery, composed of a bevel wheel *e*, its axis *f*, and its communication wheel *g*. It consists farther of two fluted cylinders *h i*: that marked *i* (see the upper wheel) being mounted in a moveable frame *k*, and pressed against *h* by the spring *l*. Of the two bevel wheels *e e*, one works in *c*, and the other in *d*, through a slit in the plate of the wheel A. If, therefore, one of the wheels as A, were to revolve about the common centre while the other remained at rest, the bevel wheel *d* would turn the circulating wheel *e*, and give motion to the drawing cylinders of the wheel A; and the same effect would be produced in the wheel B by the wheel *c*. But in such case the motion of the drawing cylinders would be too great relatively to the twisting motion of the whole; and therefore a rotary motion is given to both A and B in the same direction, in order that the drawing tendency may be the result of the *difference* of such motion, by which means a great deal can be twisted against a moderate length of drawing, which would have required more complicated mechanism, had the drawing motion been taken from any *fixed* pinion, which last method may however be adopted when thought proper. An essential property of this mechanism is, that it draws and twists
at

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at the same time in any desirable proportion, and also that it smooths and refines the thread between A and B, with little or no addition of twist, in order to prepare it for the last operation of twisting and winding on the bobbin; but note, that sometimes only *one* of the drawing systems, as *A e h i k*, is used, when the kind of thread admits or requires it.

It may be as well to precede the description of the most usual form of this new spinning machine, by some general observations on the use of oblique cards, which are hereby claimed as a new invention.

If in Fig. 24 the card A B turn in the direction A B, having its wires hooked in the direction of the arrows, and if in the part of the oblique card C D which touches A B, its teeth be directed like the punctuated arrows *a*, then these teeth, after the card has made half a revolution round its axis *y z*, will be placed in the direction of the black arrows *b*, the points directed downwards: and if then a circular comb formed like the crown-wheel of a watch be applied with its teeth parallel to the hooks of the card, such comb will strip the card of its contents by driving back the filaments in the same lines they were laid on in by A B, but in a contrary *direction*; thus producing a *roller* like that *cross* one produced by common carding.

But if, as in Fig. 25, the card A B turn the same way while C D is sloped the contrary way, having its teeth positioned as the dotted arrows *a*, then the hairs or filaments will leave A B, and be placed on C D obliquely *across* the hooks of its card wires, and when these shall have been carried half a revolution round the axis *y z*, they will be found in the position of the black arrows *b*, that is nearly horizontal, with the filaments nearly vertical.

tical. In this state of things a similar comb, whose teeth should be directed in the same lines as the card wires, would sweep the filaments off the card by taking them nearly at right angles, producing a ribbon composed of hairs placed, somewhat obliquely, in the direction of its length, which is the best position for the subsequent operations of spinning when a smooth thread is required. The former operation being preferable when a hairy thread is wanted, as for cloths, &c.; and they both grow out of the use of oblique or diagonal cards, on which in general this branch of the invention is founded. And with respect to this obliquity, it admits of an infinite variety, as well in the relative position of the touching cards, as in that of the hooks or wires on *each*; there being no other bounds to this variety, but a parallel position on the one hand, and a right angular position on the other.

A series of these narrow cards with diagonal teeth are also sometimes put on a cylinder or cone A B, Fig. 26, which is made to work against the cylinder of a common card as C D, same Fig. (placing another series opposite to these, so as to sweep the intervals *a b c*, &c. of said cylinder), as two sets of common straight hooked cards have been before done, and to these diagonal cards the circular combs *d e f g* are applied; and under or near them an equal number of *spinners*, such as A B, Fig. 23, or bobbins *m n*, Fig. 22, or both if necessary. See their places at *h, i, k, l*, when this form is employed.

Another new method of dividing into several portions or ribbons the *sheet* of filament which is found on a given cylinder of any card is this: a series of divergent cones, *a, b, c, d, e, f*, Fig. 27, are used for that purpose, each turning on its own axis properly inclined and touching said

said cylinder in the line A B ; these cones are furnished with diagonal (or straight) cards ; if the former, the combs are applied immediately to them, and near these an equal number of spinners or bobbins, in the manner just mentioned. See also *h i k l m n*, Fig. 27. This system of diverging figures may be also used to open long filaments ; and that by fixing to them proper cards or hooks, some leaning to one side and some to the other (but in general more to one side than to the other). When therefore any mass of filament is laid on these hooks in the line A B, that mass will be considerably widened in the line *h n*, and lie across the series of figures. And here the filament is unhooked by a set of thin rollers placed in the intervals of the Figs. *a, b, c* ; as is shewn in the Fig. 28 ; where it is evident that if *a* turn, *b* will turn also (by the pressure of the transverse filament), and will drive off the filament stretched between any two figures *b, c* ; and so for the other figures.

Another method for opening and carding filamentous substances is this. On a body of a proper figure A, Fig. 29, are placed the necessary hooks or card-wires, which by the contact of other bodies B, C, opens and cards the filament in the usual way. But here, these hooks are placed in circular rows, and between each pair of rows passes a portion of an endless line or chain E, going from the said body to that D, and returning under A, until all the intervals are filled ; when the two ends of the line are brought together by means of proper direction-pullies. If then the bodies A and D turn, any filament engaged between the hooks of A, will be pushed off by the lines where they leave F in a tangent ; and thus be ready for re-carding or spinning, as may be thought proper : and note, that the series of lines at E serve

serve at the same time as a *feeding-cloth*. The same system may also be applied to the same purposes *without lines*, and that by suitable metallic rings A B, Fig. 30, hung round a body C of a smaller diameter, and between its rows of teeth as before-mentioned. Here it is evident that if C revolve, A B will roll on its surface (weighed down if necessary by the cylindrical weight D), and thus push off the filaments at E, the motion of C being in the direction of the arrow.

One of the practical forms of this invention shall now be described. *a a*, Figs. 22 and 31, (Pl. I.) are the feeding cylinders which receive the cotton in the form of a ribbon, and deliver it (by a slow motion taken from the central axis through the wheels *b c*) to the central horizontal card A. Observe also in Fig. 31, a new method of feeding by enveloping one of the feeding cylinders with an endless cloth or leather *d*, so placed round a roller above *d*, as to bend (more or less according to the length of the staple) round the card A; and press the cotton or wool softly against it; and thus equalize the feeding, and save the card from injury by any metallic contact. One or more endless cloths or leathers *x y* may be used, made to run on rollers as swift as the card, and to cover the naked parts of it, so as to prevent the filament from being thrown off by the centrifugal force. From A the cotton (or other filament) passes to the oblique card B, whose teeth are placed as before explained in Fig. 24. This card receives its motion from the central axis, by the wheel and screw *e* applied to the wheel *f*. The said wheel and screw being supported in a frame formed like the dotted lines above B. The circular comb *h* placed obliquely with respect to the card B, plunges its teeth

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between those of the card, turns by the contact and strips the card of its filaments which are immediately taken from the comb, by the spinning system described in Fig. 23, and placed at *i* in these figures. From this latter machinery the thread descends to the spindle *s* & *t* the flyers of which move a little faster than the bobbin *m* & *n*, so that the difference winds up the thread just as fast as the spinning system furnishes it, and the strong thread, by the form of the bobbin, drives down what was already wound, so as to gather a very large quantity before it becomes necessary to change the bobbins. The latter, it must be noted, is covered by a cylinder *r* & *x* fixed to its bottom, and rising nearly to the top, so as to prevent the thread from flying unequally off the corners as the bobbin diminishes to give it room. *g* & *r* are the two wheels, whose unequal numbers acting on equal pinions, cause the winding difference above-mentioned.

N. B. This machinery may work upward as well as downward, or the card axis may be horizontal and carry several central cards, opposite to several drawing systems and spindles; but the principles would remain the same.

Sometimes the filaments may be taken directly from the card B by the spinning system, and also by pressing cylinders having no motion but round their axis. The same may also be done from the comb, either delivering the filament directly to the spindle *k*, or to the spinning system. Sometimes one or two pairs of drawing cylinders without twist, are interposed between the machinery *i* and the spindle *k*; in order to refine and smooth the thread previous to twisting.

In the former part of this specification, two forms of the watch or untwister have been explained. Another form

form shall now be given, which is perhaps more convenient, although its principles be the same.

A B. Fig. 32, (Pl. II.) is the section of a wheel like those of Figs. 22 and 23, turning on a cannon C. In this wheel is screwed the untwisting machinery D E, composed of some sharp grooved pulleys *a, b, c, d*; which receive, and bend the thread as it passes through the cannon C, from the giving to the taking cylinders. The two pulleys *b c*, are mounted on screws fixed in the moveable plate *e*, which can assume the position *f g*, by which means a wire or hook passes directly from D through the cannon to bring up the thread: and *this*, when *e* resumes its present position, is bent four times, *viz.* to the right of *a*, to the left of *b*, to the right of *c*, and to the left of *d*, where it leaves the machine in the prolonged axis of the cannon C. These bends of the thread and the action of drawing so connect it with the pulleys, that turning round the cannon C, *they undo any required proportion of the twist contained in a given thread, which thereby becomes extensible as before mentioned.*

Fig. 33 represents another form that may be given to the receiving system. *s* is the spindle turned by a proper wheel working in the pinion *p*. The wheel *a*, at once cylindrical and bevel, runs loose on *s*, and receives its motion from another wheel in the manner of those *q r*, Fig. 22. The pinion *p* goes through the bottom of the circular box *q r*, and communicates the motion of *q* to the wheel *c*. But the wheel *c* is a part of the flyers *d e*, which turn on the upper end of the spindle *s*, receiving the thread at *h* from the spinning system. Now if these flyers, and the box *q r* turn together but with a different velocity, the thread brought by *d e* will be thrown against the hollow sides of the box and carried

gently round it, so as to be gathered up as fast as it leaves the other machinery; and thus will be obtained the triple object of winding up a very weak thread without danger of breaking, of winding up a large quantity without stopping, and of winding it at once in the form of a skain, so as to avoid the necessity of reeling.

N. B. The flyer *d e* might be turned from above by a pinion at *x*, and thus the wheels *a b c* be suppressed; but the taking out of the thread would be less convenient.

Fig. 34, shews a different method of placing the circular comb (*h*, Fig. 22). If *A B* be a card (similar to that *B*, Fig. 22), the comb, placed as at *e*, with its axis directed toward that of the card, and its teeth plunged among those of the card, will drive off the filaments as at *f*, where they may be taken immediately by the spinner, Fig. 23, or any other mechanism having the property of twisting and drawing at the same time. The dots on the card shew the direction of the card-wires in this instance.

It may be now proper to mention and describe several other new methods of preparing and spinning filamentous substances. Let *A*, Fig. 35, be a card or comb for receiving the filament delivered by the feeding cylinders *B* (placed as well as *A* in any given position). When *A* revolves, *B* gives out the filament with a proper velocity; but the same *line* in the *ribbon* of filament is always placed on the same circle of teeth in the card, whence arises more or less inequality of thickness in the *sheet* of feeding. To prevent this imperfection, a backward and forward motion in direction of the axis of *A*, is given to the frame which carries *B*, as is expressed by the two *arrows* on *B*. That motion is here given by a crank *C* of very small radius, moving swiftly, and thus changing
con-

continually the place of the approaching filament on the card A. This system is called the *shaking feeder*: and it should be observed that as it is necessary the shake should be nearly parallel to the surface of A, the frame which contains B must move in a slide, or round a centre far beyond D.

In Fig. 36 is shewn another system of feeding, which is called the *throwing feeder*: and this is its principle. A is a kind of hollow box, containing the filament in a state of ribbon (or connected longitudinally in any other state). When the box turns, the wheel D circulates round the pinion C, which is concentric with the axis of revolution of the box, and is either fixed or turned *with* the box as the necessary proportion of draft may require. By these means one set of the pressing cones (or cylinders) $x y z$ receives, and communicates to the other sets the motion necessary for drawing the filament out of the box and delivering it at E with a proper velocity: and as the cylinders z , are at a distance from the centre of motion of the box, they describe a circle round it, and would deliver filament to any number of combs or cards that should be placed in that circle (say those B, Fig. 22, (Pl. I.) or A B, Fig. 41).

Fig 37 shews another method of feeding applicable to long filaments, such as flax, &c. It is a cylinder a , through which passes an endless ribbon, made of any proper material, whose width is just equal to the inner circumference of a . This ribbon passes over two rollers B C, one of which, aided by a third roller, presses it, and draws it forward in the direction D, $a c$. By these means the ribbon changes its place in the cylinder, so that any wool or other filamentous substance laid on it at D, will be rolled up on entering the cylinder, and there

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like that of Fig. 41; the revolving cards of common machinery; or, in fine, either of the new alimentary systems just described. In some, and perhaps in most cases, it will be best fed by the eccentric feeder of Fig. 36, so placed as to throw the filament on the plates in a diagonal or helical direction, as shewn by the arrow, Fig. 40.

This system under several other *forms* is also used, one of which is shewn in Fig. 42. There the plates above described are successively less and less; so as when united to form a kind of cone, see *a b*, while the teeth are placed on them either as in Fig. 40, or parallel to the axis of their motion, or in a divergent or convergent position. Sometimes these differences of diameter are made, such as that the section of the whole may offer a circular hollow *c d*, to which any round card or comb E (or the centrifugal feeder), may apply with exactness, so as to give filament to all the plates; but all these *forms* are branches of the *same* invention.

Another means of separating the several partial ribbons formed on the above-mentioned system, consists in giving to each successive plate a different centre and a different diameter. Thus in Fig. 43, all the circumferences would coincide at *a*; but at *b*, would be far enough asunder to permit the twisting of each *fascies* without mixing several together. The figure shews *how* this eccentricity can be obtained, *viz.* by the insertion of lunular prisms *c, e, n*, to fill up the difference between the diameter of any given *cannon*, and that immediately above it. It is hardly necessary to observe that the motions are given to *these* plates by proper wheels, as in the case of Fig. 40.

Another

Another system employed for producing small ribbons of any filamentous substance is shewn in Fig. 44. The throwing feeder, or a circular card, is placed in the centre C, and round it any proper number of combs *a, b, c, d, e*, converging to the circumference of the given circle, so as to mix their teeth as it were, and form there a kind of card, receiving filament from either of the above feeders. These combs have a *given* motion round their respective axes (either *all* the same way, or every other one in a contrary direction), and by their divergency the filament is separated into a number of equal elements, that need only be twisted at *f g h*, &c. to form distinct threads, which is the object in view. Note, These combs are straight or *plane* as at *a b*, conical as at *m n*; or cylindrical, with their teeth sloped to the right or left as their various positions and motions may require. They are also composed sometimes of several plates with unequal motions, like the system of Fig. 42; and note, That sometimes other combs, as *O* (placed obliquely in an opposite position) are applied, which, by their motion in different planes, comb and smooth the filament for the subsequent operations of spinning; and this last system assumes any proper dimensions, according as it is intended to *open* large quantities of filament, or to produce small ribbons to be spun immediately as in its present connection.

Another system of spinning which is claimed as a new invention is the following.

A, Fig. 45, is part of a revolving card filled with a filamentous substance (or it represents the circle in which the throwing feeder revolves), and B is a conical comb with its teeth converging towards the centre, and represented by its section *a b c*. This comb turns on a

hollow axis B C, and receives from A a constant supply of filament thrown on *those* teeth of the comb, which successively assume the position *a b*. But as in the tube B C there is a thread placed, which the machinery draws at C, but without twist, it is the motion of the filament at *a* which twists the thread in the tube, and combines constantly with it those hairs which are snatched by the comb from the card: and thus an endless thread is produced, which can be wound directly on any body D without further twisting, whence arises a considerable degree of simplicity in the rest of the machinery.

That *form* of the system which has been just described, requires a perforated axis to the comb B; but it is possible to use the system without it. Thus in Fig. 46, A is the comb, and B part of the delivering card. A turns on a *solid* axis C, while at D there is a ring or eye fixed, through which the nascent thread passes to go to the bobbin or reel, (for either may be used). The inspection of the figure will complete the explanation, when it is added, that the teeth of the comb A may assume any proper position in the surface of A, and that the comb may be simple or composed, see Fig. 42. It would be also possible to twist the end D of the thread, which would accelerate the work *per spindle*; but it would occasion more complication in the machinery.

Fig. 47 represents another method of using these combs: A is the card as before; and B C the section of the comb. The latter turns with a certain degree of swiftness, but only just enough to carry the filament from C to B, while the fly and bobbin D E draw it off, and twist it in the manner heretofore described.

It

It must here be remarked that this new system of twisting the thread, by throwing its component parts round its axis, permits the introduction of double, treble, or *multiple* spinning. In other words, it permits the spinning of cords with any given number of strands and with any material. Thus the form represented in Fig. 48, produces a twine with two strands; or as it is called in some manufactories, a thread *doubled and twisted*: and nothing prevents combining a greater number of strands at the moment of spinning them; which is at once a proof of the newness and the excellency of the system.

Another method of spinning, which admits also of combining several threads, and is principally adapted to the spinning of long-stapled materials shall now be described. To shew it in its most simple form, let A B, Fig. 41, be a comb (of any of the afore-mentioned descriptions), carried round the axis *c d* by means of the wheel E F, and revolving at the same time slowly round its own axis by means of the pinion *a* moved by the wheel *b*; the latter urged by the fixed pinion C, round which it circulates. Let further G H be a feeding system of any of the kinds heretofore mentioned. Then, the comb A B, every time it passes the feeder, will seize a few of the filaments there offered; and carry them successively to L, where they will be twisted and drawn through the eye in a state of thread, as before stated.

If then several of these doubly revolving combs be placed round a common axis A, Fig. 49, and moved by the wheel B, acting on the pinions C D, while an equal number of *feeders* E F, supply the material; in this case they will each produce a thread G H; and these, being once brought together, will produce a cabled

thread at O, which will take its twist from the combined action of each strand G H, as in the common methods.

But that nothing may remain vague or variable in this operation, Fig. 50 is the plan of a method that has been adopted to fix the ratio between the twist of each strand and that of the cord resulting from its union with the rest. A B is a fixed wheel or ring with teeth on its inside. C D O are the wheels which give motion to the combs *a b*, *c d*, *e f*, as in the last figure. E F H are three feeding systems, so placed as that the progress of C D E in A B shall always bring the teeth of the combs to act on the filament they furnish. Thus when C comes to D, the comb *a b*, which now takes from E, will then feed upon F, and so of the rest. Every comb will take successively from every feeder; and thus the whole card must necessarily be cylindrical, if the whole feed be equal; for should any one comb take too much filament, the next must take as much too little, &c. But observe also that the centres of C D E move in different directions from their circumferences: or in other words, the common axis P moves contrary to the partial ones *n*, *o*, *p*; and thus when the velocities are properly co-ordinated, they give naturally and constantly to the cord that quantity of twist in one direction; which the opposite twist of the strands requires. In this case the former is to the latter as one to three; but if any other ratio were required, the wheels C D E must bear other proportions to the ring A B, and the number of the feeders E F H must be increased or diminished in the same ratio.

Fig. 49 will represent the elevation of this plan, if we suppose the axis A lengthened to O; the fixed
ring

ring applied at $x y$; the piece K carried round with the axis $A O$; and the wheel B suppressed.

In a preceding part of this specification is contained the principles of a new method of opening, arranging, and even spinning filamentous substances: and that by the displacement of the points or teeth of which the comb-hackle or card is composed, with respect to each other. The Figs. 51, 52, and 53 here annexed, give one of the forms of reducing that system to practice.

$A B$ is a frame of wood, carrying among other things a potence x , which supports certain pulleys or rollers y , the use of which, combined with the toothed wheel w , is to keep the rings $u v$ (say eight in number, more or less), in the position which will be more fully explained. The diameters of these rings are such, as that when they all lie flat against each other, having the end of a given diameter of each in the same plane at t , the other ends of these diameters, the points included, are found in the circumference of the circle $q r s$, described about the centre P , according to the principle already given. Those rings are all furnished with teeth or points $u v$; and their inside is cut into teeth, which receive motion from the wheel w ; but as this wheel works alike into all the rings, the motions they receive differ in proportion to their diameters. The centre P of the axis R carries, on a proper support of metal, the horizontal axis $o o$, each end of which is furnished with a spherical or conical comb m and q , the teeth of which point inward; and both which combs in turning round P , pass the feeding rollers n , seize a portion of filament, throw it on the teeth of the rings $u v$, and comb it by successive passage, until it is carried away by them towards t . It must also be observed, that the combs $m q$ (by means of

of the screw and wheels 1, 2, 3), have a slow motion round their own axis, and thus the filament they take at *a*, cannot remain long upon them, but wholly passes to the points of *u v*, after having been *combed* by frequent passages near them. It need not be added that the feeding cloth 4, 5, receives its motion from the axis of *w* by a chain and wheel 6; and that the feeding cylinders *x* as well as the wheel *w*, and the receiving cylinders *t*, take theirs from the central axis *R* by the wheel work and screw 7, 8, 9, while the central axis is turned from above by a separate arbor, connected with it by a fork at its upper end near *o*.

Thus then the wool or filament distributed on the cloth 4, 5, is given by the rollers *n* to the combs *m q*; by them to the rings *u v*; whose unequal motions necessarily lay the hairs in length, and in as many fascies as there are intervals, while the receiving rollers *t*, moving a little faster than the said rings *u v*, draw out the filament, and unite it into a *ribbon* fit to be spun *at once*, by the oblique card-spinning machine already described, to almost any degree of fineness.

In order to be able to receive thread or yarn *very* little twisted, and of course very weak, without danger of breaking it, under the *spinner*, described in one of the figures in the preceding part of this specification, (*viz.* that mechanism which, receiving the wool from the comb, *begins* the thread and delivers it to the bobbin), is placed the cone or hollow body *A*, Fig. 54, open at the top *a*, and having round or under it one or more spiral spaces *c*, so placed with respect to the *twisting* motion of the body, as by it to create a partial vacuum in the abrupt recess *b*, and thus to *suck* in the thread at *a* with more or less force, as the velocity and the opening *b* is greater or smaller.

smaller. And in some cases the said *spinner* is suppressed, by fixing to the top of this cone at a one of its drawing systems, receiving motion from a fixed pinion, which serves at the same time as a collar for this end of the cone to move in. Or in fine, if a *fixed* pinion should give too much drawing tendency (as was before observed), then with a proper wheel a motion of its own is given to that pinion, differing from that of the cone and drawing system, that the effect may be as desired.

In witness whereof, &c.

Specification of the Patent granted to WILLIAM NEWBERRY, of St. John Street, in the County of Middlesex, Gentleman; for an Invention of certain Machinery for the Purpose of sawing Wood, splitting or paring Skins, and various other useful Purposes.

Dated January 30, 1808.

With a Plate.

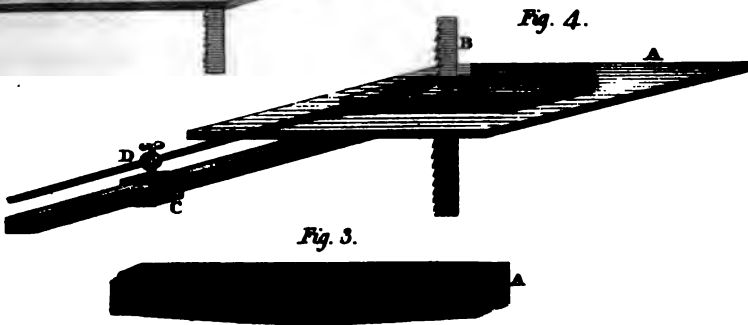
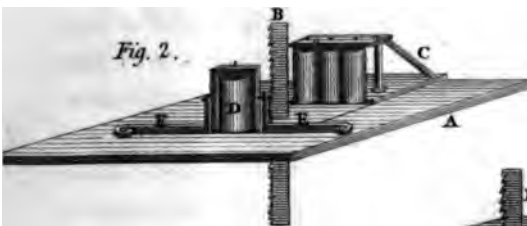
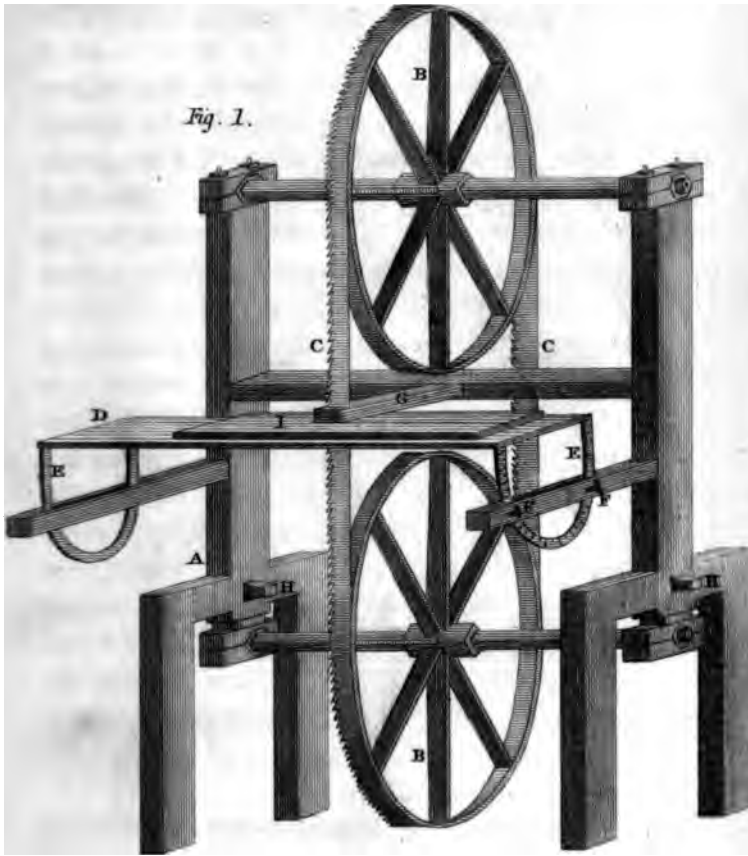
TO all to whom these presents shall come, &c.
NOW KNOW YE, that in compliance with the said proviso, I the said William Newberry do hereby declare, that my said invention is described and ascertained in and by the drawings hereunto annexed, and the following description thereof; that is to say: First, my invention consists of a method of working an endless revolving saw-blade over two dumb wheels or rollers, to be used for any of the purposes to which a common saw may be applied; to this sort of saw a variety of machinery may be attached for guiding the pieces to be cut, for the manner of doing which the annexed drawing will give an explanation.

Fig.

32 Patent for sawing Wood, splitting or paring Skins, &c.

Fig. 1, (Plate III.) A, is a cast-iron frame to carry the wheels. B B are the wheels, having each an iron plate screwed behind it, to prevent the saw from running off backward. C C is the blade of the saw. D is a bench or platform on which the piece to be cut is laid. E E are two semicircles of iron fixed thereto, whose centres are parallel to that part of the saw-blade which is even with the top of the bench; one of these is marked with the divisions of a circle, by which means on turning them in the sliders, the bench may be placed at any angle to the blade of the saw, and there fixed by means of the screws F. G is a guide to keep the saw from running out of its line; close under the bench is another guide like it. H H are two wedges to force down the lower wheel, so as to give the saw the necessary tension. I is the piece to be cut, which may be brought forward to the saw either by hand or by passing it between rollers in the well-known way now practised for drawing iron, &c. therefore, on carrying the wheels to revolve by any moving power, the saw continually passes through the piece till it is cut.

Fig. 2, are guides for cutting parallel pieces from any kind of planks or boards. A, is a part of the bench; and B, of the saw. C is a slider, having in the end of it any number of small rollers parallel to the saw; this slide moves in and out at pleasure, and is fixed by a thumb-screw. D is a roller fixed to a universal joint, and pressed in by the springs E E; therefore upon C being fixed at any distance from the saw, the roller D pressing the piece close against C, a parallel piece is taken off throughout, however the plank may be warped or twisted; if the bench is elevated so as to cause the rollers in C to form an angle with the saw, a feather-edged piece is taken



taken off. If any shape not much out of a line is wanted, it may be cut by laying a pattern by the side of the piece.

Fig. 3, A is the piece to be cut; then by laying on the pattern B; and fixing the rollers in C, Fig. 2, the saw will pass the dotted line corresponding nearly with the outside of B.

Fig. 4, is a guide for cutting circles of all sizes; A is a part of the bench, and B of the saw; C is a socket sliding on a rod which is marked, so that the centre of the intended circle is immediately determined from it; D is a rod and pair of claws turning on a centre to guide the piece to be cut, then by fixing the socket C at the proper distance from the saw, the piece is passed up to the saw in the required width. Secondly, for splitting or paring of skins, the two wheels are laid level instead of being over each other, and an endless knife is worked upon them, to which is affixed two whetstones one above and the other below it, so as to sharpen the knife as it goes; it is used with the rollers, &c. of a common skin splitter; the plate of steel for the saw or knife may have its two ends rivetted and brazed together, or they may be shut before it is brought to its thinness, and drawn down afterwards. Although I have described the saw or knife in the way I have made it, yet it may be put in a variety of other forms, either with working it over one roller with the assistance of slides, or over more than two rollers, or may be kept on the rollers by pegs or stubs on them with corresponding holes in the saw; the framing may likewise be made in a variety of shapes of wood or metal; but the one here described answers every purpose. In witness whereof, &c.

*Specification of the Patent granted to FRANCIS PLOWDEN,
of Essex-street, near the Temple, London, Esquire;
for newly-invented Aphthartic Viands; being Butcher's
Meat, animal and comestible Substances, preserved
without Acid, Salt or Drying, in a sweet, palatable and
nutritious State, fit for Consumption both at Sea and on
Land, for an extraordinary Length of Time.*

Dated June 13, 1807.

TO all to whom these presents shall come, &c.
NOW KNOW YE, that in compliance with the said proviso,
I the said Francis Plowden do hereby declare, that my
said invention for preserving butcher's meat, animal
and other comestible substances, in a sweet, palatable
and nutritious state fit for consumption both at sea and
on land, without acid, salt or drying, for an extraor-
dinary length of time, is performed on the principles
and in manner following; that is to say: Putrefaction
is a spontaneous decomposition of the elementary com-
ponent parts of the putrefying bodies. Although the
atmospheric air be not the sole efficient cause of putre-
faction, yet the contact of it evidently favours and ac-
celerates putrefaction; consequently the preservation or
security of such bodies from the immediate contact, and
as much as can be from the influence, of the atmospheric
air, must proportionably retard and prevent putrefaction,
which is effected by the evaporation or exhalation of
elementary parts. If, therefore, these bodies whilst
sound and untainted can be closely enveloped in an air-
proof medium or substance, so as to prevent evapora-
tion or exhalation, their decomposition must be arrested

as long as the circumambient preservative continues to resist the admission and action of the air. The texture or quality of such incrusting substance or medium of preservation, must not only resist the effects of the atmospheric air, but it must not communicate any noxious quality to its contents. The substance of which I form this incrustation is very highly dried essence or extract of meat. The substance to be preserved being dressed will preserve the longer, and it should be put into the vessel in a cold state and wiped dry. Care must be had that it contain no insect, vermin, or other immediate active cause of corruption, or any particle of inchoated putrefaction *. Every part of the substance to be preserved should be completely enveloped with the extract, so that no vacuum or interstice be left open; and it should be applied in that fusible state as to find its way into every vacuum. The vessels are best of wood, and should be kept as dry as possible.

In witness whereof, &c.

* If this essence or extract be properly made, the advantage of its affording pleasant, wholesome and nutritive soup or broth, and its general utility for all culinary purposes, will be incalculable. The process of extracting the gelatin from the animal substance will be attended with this further economical effect, that it will leave the membrane and all other parts of the animal substance (except the earth and bone) in the immediate state of preparation for being converted into soup. And as to the earth of the bones, that will afford phosphoric acid, which may be converted into that species of phosphorus which is in high estimation and very valuable to refiners.

*Specification of the Patent granted to BRYAN DONKIN, of
Dartford, Kent, Millwright, for a Mode of producing
a rotary Motion applicable to useful Purposes.*

Dated August 3, 1803.

TO all to whom these presents shall come, &c.
NOW KNOW YE, that in compliance with the said proviso, I the said Bryan Donkin do hereby declare, that my said invention is described in manner following; that is to say, I carry my new method of producing a rotary motion into effect by introducing a steam beneath the surface of water, or any other dense fluid, at a temperature too elevated to produce any notable degree of condensation in the same; and I dispose or present within the said water or dense fluid, and immediately over the place of introduction of the said steam, a certain inverted vessel or bucket; which, when filled with (and rendered buoyant by) the said steam, will ascend with considerable force, and carry along with it any other moveable apparatus to which it may be attached, until the arrival of the said vessel or bucket to such a place or position as shall permit the said steam to escape. And I do dispose, arrange, and combine, various other such buckets or vessels as aforesaid along with the first-mentioned bucket or vessel (either by fixing the same to the periphery of a wheel, or to a circulating chain, or by any other convenient and suitable method), in such a manner that the ascent of any bucket or buckets containing steam shall regularly and successively cause the other bucket or buckets to arrive at the proper situation
for

for becoming likewise charged with steam, and ascending in their turns. And I do declare that my said method of producing a rotary motion doth consist in the construction, use, and application, of the apparatus as here described and combined, namely, of the usual steam boiler or boilers, and of the receptacle, with its charge of hot water or other dense fluid, and of the combination of buckets, by a revolving wheel or by an endless chain and buckets, or by any other of the well-known ways of applying buckets (in cases where the direct weight, and not the buoyancy of a fluid, is used as the first mover); and that the motion so produced in the shafts or arbors of the wheels round which the said buckets, in all and every such case and cases, must pass or revolve, in consequence of their successive ascent in the said heated water, or dense fluid, is the rotary motion meant and intended to be produced by my said new method; and moreover, that I do apply the said motion or force to mills, and to other useful purposes, by the usual and various means of connecting first movers with the several kinds of work intended to be done: all which are too generally known and understood to be repeated in my present specification. In witness, &c.

*On the distinctive Difference of Messrs. CHAPMAN'S and
Mr. CURR'S Patents for Flat Ropes.*

*Communicated by Mr. W. CHAPMAN in a Letter to the
Editors,*

GENTLEMEN,

HAVING observed, since the specification of the patent granted to myself and Mr. Edward W. Chapman, for the formation of "*flat bands or belts* to be applied to the drawing of minerals from mines," has been published in your Repertory, that this invention has been represented in another publication so nearly similar to that of Mr. Curr, of Sheffield, for *flat ropes*, as to possess no very distinctive difference; I therefore feel it incumbent on me to state the grounds on which the patent for flat belts was taken out; and to say, that as a possessor of other patent property, exclusive of more liberal motives, I should be one of the last to think of infringing on the rights of others.

Mr. Curr expressly states that his method of making flat ropes is to lay two or more *small ropes* side by side, and to secure them in that position by stitching or interlacing, or by any other method; therefore, it is clear that Mr. Curr confined his invention to what he designed it to be; viz. a *more useful combination of small ropes* for the end which he proposed, than the making of *one great rope* for the same purpose; but by no means to preclude the stitching or interlacing together of other substances than rope, because the art of stitching and interlacing of things together was not of itself new. The question therefore rests on the distinctive difference between a rope and any of its component parts, particularly *the strand of a strand-laid rope*, which (well knowing that a
strand

strand is a term occasionally applied to a *strand-laid rope itself*, when three of these are made into a cable-laid rope, by being twisted round their common axes), Messrs. Chapman have, to prevent misconstruction, described as being composed of any given number of yarns twisted together round their common axes; and which cannot of itself be called a rope, although a component part of one. I conceive that no one sending an indefinite order for a rope, would consider his order complied with if the rope-maker was to send him a primary strand composed of rope-yarns twisted together, *which, when stretched at length and left to itself, would immediately open out*. It would avail little for the rope-maker to say, "you have only to cut the strand into three parts, and twist them together the contrary way, and *they will then become a rope*." He might with nearly as much propriety have sent the rope-yarns, or even the hemp, for each of them would have been constituent parts, but not the thing wanted. From these premises it clearly follows, that Messrs. Chapman's flat-bands, or strand-belts, are not made of ropes; but of a distinctly different thing *which they have defined*; and consequently they can have no exclusive claim to any other description of flat bands, even if they were composed of rope-yarns, which are the immediate constituent parts of a primary strand, *the same as the latter is of one description of rope*, every kind of which is fairly included in Mr. Curr's patent; because a rope of any description is for its purposes a complete manufacture. It is evidently not so with primary strands for the reason already given, that the twist would open out, and they would become a loose body of yarns; therefore any *new process* of combining such strands together, or any *new form* when combined, is certainly patent.

patentable, more particularly if useful to the public; consequently, if Messrs. Chapmans' invention also possess this qualification, it has, as to distinctive difference, all that can be wanted. It appears that a strand-laid rope composed of *three strands*, is one sixth part shorter than the strands it is formed of, and only *twice* the strength of a *single strand*. It therefore follows that in point of strength, or in *reduction of quantity to produce the same strength*, the invention must be highly advantageous to the public; provided the duration of strand-belts be, in any instances where they are applicable, nearly equal to that of flat ropes; and there is nothing in theory against their being completely so.

Prior to the inventions of either Mr. Curr or Messrs. Chapmans, flat bands have been made various ways in the different forms of girth-web made from untarred rope-yarn or hempen-yarn; but this application of yarn, or the application of this species of belt to the drawing of coals from mines, to which purpose it is not inapplicable, operates against neither of the inventions in question, although they are all composed of the same primary manufacture, *viz.* of hempen yarn, which is as distinct from a primary strand as such a strand is from a rope. The distinction may be still continued, although the process shall have approached much nearer: *viz.* all the yarns for a strand stretched at length and bound together, so as to form what sailors call a *salvagee*, and which Duhamel and others have supposed to be the strongest mode of combining the strength of yarns*, may be

* A salvagee is much stronger than a common primary strand (the only one known when Duhamel and other authors wrote, who are quoted in the *Encyclopedie*), but inferior to a strand made on the
new

be used in any manner. The salvagee differs from a primary strand only in not being twisted, which is much nearer to a primary strand, than that strand to a rope. Yet I do not conceive that Messrs. Chapman could have a just plea to prevent any person so inclined from stitching these salvagees together side by side, and applying them to the drawing of minerals. Neither can they or Mr. Curr have any just plea to prevent any one from stitching together, side by side, knittles*, sennet, or gaskets (all of which are composed of rope-yarns), and applying the flat band thus made of them to the drawing of minerals, to which they would be perfectly applicable. Messrs. Chapman contemplated all these combinations, and saw the relative imperfections of each, as well as those of ropes themselves laid side by side; and

new principle, by which all the yarns bear alike, or nearly so, at the point of breaking. This circumstance arises from the inequality of rope yarns, which if simply stretched in one mass, no otherwise combined than by ligatures, would, on a general tension of the whole, *each of them break in its weakest part*; but when twisted into such a strand as described, they combine one with another, and *each yarn bears its average strength*, which, as the weak parts are generally a small portion of the length of each yarn, is much further beyond the least strength of each yarn than what is lost by the angle they form to their common axis when twisted into a strand. Thus a primary strand made on the best principle is *the strongest application of rope-yarns*: therefore, any *more advantageous combination of strands* than has been used before *must be a beneficial invention*.

* *Knittles* are flat lines composed of three rope-yarns platted together. *Sennet* consists of five, seven, nine, or any larger uneven number of yarns, combined together in a platted form by a process not necessary to take up the reader's time in describing, but which produces some resemblance of two cylindric bodies connected together. When this manufacture is made with an eye at one end, and tapered at the other, it is called a gasket, and is used, when ship-masts are furled, to wrap round them, and bind them to the yards.

having decided by experiments the superior strength, and conceived the probable utility to the public and to themselves that would result from *this novel combination* of primary strands; they, similarly to the practice of many others who have invented *useful combinations*, applied for and obtained his Majesty's Letters Patent. I have purposely used the word *combination*, because by much the major part of inventions are *new combinations*, and nothing more; whether in machines which are necessarily formed of wheels, screws, &c. which have individually and conjointly been used various ways; or in manufactured articles, which are formed of wood, iron, hemp, flax, wool, &c. all of which have been used individually and conjointly.

I conceive that no invention is entitled to public protection but on the basis of utility. The obtaining of any end to which *the public are in possession of an equivalent* would defeat itself, because no one would be induced to pay for its adoption. If, on the other hand, an improvement has been granted to an inventor, I conceive that any small deviation to obtain *the same end* only would be a piracy; but, if it either be to obtain *one more valuable*, or to shorten the process, and *reduce the quantum of materials*, without adopting any part of the other than what is common, then the invention is obviously a new one; and on this ground the patent for strand belts has been found to stand conspicuously, particularly at this period, when hemp is so much wanted for the purposes of our navy both military and commercial.

Exclusively of the circumstances peculiar to the thing itself, I conceive there is both novelty and utility in performing the operation of combining strands or other pliable
able

able substances together by a locomotive machine, because it admits of the operation being performed when the separate parts are extended at length and equally stretched, which is of great importance; as, from the want of this circumstance, flat ropes have been found to break their stitches when exposed to sudden jerks, which has occasioned their disuse at some collieries in Northumberland and Durham. Consequently, this part of the invention also is supported on the basis of utility, and not a mere evasion; which neither necessity nor inclination would have led the parties to have had recourse to. If I have placed this subject in a new light, no other merit is due to me than that which necessarily arises from a combination of practice and theory.

I am, Gentlemen,

Yours, &c.

Newcastle, May 4, 1808.

WM. CHAPMAN.

Description of a cheap Apparatus for filtering and purifying Water, invented by Mr. J. I. HAWKINS, of No. 79, Trichfield-Street.

Communicated by him in a Letter to the Editors.

GENTLEMEN,

AGREEABLY to the intention announced in the account of the *Museum of Useful and Mechanical Inventions*, inserted in your last number, I now send you the description of another of the articles there deposited for public exhibition.

A cheap Apparatus for filtering and purifying Water.

This apparatus consists of a vessel of wood, metal, earthen-ware, or other convenient material, having

G 2 holes

44 *Description of a cheap filtering Apparatus.*

holes in the bottom, covered with a piece of thick flannel, on which powdered charcoal is laid, about two inches high. This vessel is placed over another of rather larger diameter, having an aperture near the bottom furnished with a cock; the water to be purified and filtered is poured on the charcoal, through which it gradually passes, and drops perfectly sweet and clear, into the lower vessel; from whence it is drawn off by the cock for use,

The charcoal should be made about as fine as sand, either by being pounded in a mortar, or ground in a coffee-mill; which last plan is the best, since it leaves the particles more nearly of one size; it must of course be broken into small pieces, before the mill can receive it.

Saw-dust may be burnt into charcoal, and would at once be fine enough for the purpose, if cut from hard wood; but if from soft, it must be pulverised a little more.

Some little attention is necessary in putting the charcoal into the vessel; a portion of the charcoal, say about half an inch high, must be well damped, and laid in that state on the flannel; then a second portion of about the same quantity, wetted to the consistence of mortar, is to be put on the first; afterwards a third quantity, wetted still more, should be added; and lastly, the remainder, mixed with so much water as to be easily poured on; after standing a quarter of an hour to settle down, water should be poured on, a little at a time, till it begins to drop, which, if proper care has been taken, will be quite clear and sweet, but having a slightly dusty taste, that will go off after a few hours. Should, however, the first running be a little black, it will

will not be necessary to disturb the charcoal, because that blackness will soon cease, if water be kept passing through it; and when it once runs clear, will continue to do so for many months, and perhaps years. But although it acts as a filter for so long a time, and will separate whatever of foulness is merely mixed with the water, yet it soon loses the power of attracting that putridity which is in a state of solution; and consequently will not purify more than a given quantity of water.

The following are the results of my experiments on this point.

One quart of powdered charcoal, purified;

One gallon of water, taken from the macerating tubs of an anatomical laboratory, where it had been used for many months without being changed, to soak the flesh from the bones; it was the most offensive water that could possibly be procured. The charcoal rendered it perfectly sweet.

Six gallons of green stagnant water from a pond.

Ten gallons of the worst water found in the casks on a long sea voyage.

Two hundred gallons of such water as is usually drank on a three months voyage; and,

Five hundred gallons of river water taken opposite a large city.

It must be noted, that when charcoal is wanted to purify, it must be fresh burnt; but if only to filter, that precaution is not necessary. When it has lost its purifying quality, it may be recovered again, by being heated red-hot in a crucible, or iron pot, or even an earthen one, over which a piece of tile or plate of iron is loosely laid.

In

In taking the charcoal out of the filtering vessel, a layer of about half an inch should be left on the flannel, because in that case, much less care will be required in returning it into its place again; and the water that first runs will not have that dusty taste, which it would have if the whole of the charcoal were replaced by that which is fresh burnt.

In pouring on the water, great care must be taken not to disturb the charcoal to any considerable depth below the surface, lest the water should pass too rapidly for complete filtration. This accident may be avoided by laying a piece of paper, or cloth, or even a piece of thin board over the charcoal, to pour the water on.

The size of the apparatus must of course depend on the quantity of water wanted; that now in my Museum is eight inches diameter, and the same depth, and it filters from six to seven gallons every twenty-four hours; the holes in the bottom are about one-eighth of an inch in diameter, and distant from each other about half an inch.

The flannel is of that stout kind, usually made for ironing cloths.

The purifying nature of charcoal has been known for a considerable time; but a simple and convenient way of using it, has not, I believe, yet been laid before the public; nor has its filtering property been at all taken notice of. It has been supposed necessary to use sand or some other substance to filter the water, after charcoal has purified it; but on trying a great variety of substances for filtering, I found powdered charcoal by far the best; it suffers a greater quantity of water to pass in a given time, and renders it more clear; and certainly no filtering apparatus can be made cheaper than this. It is also

also scarcely possible, that a person can be in any situation, either at sea or on land, but that he may procure such a one, in case the water he uses requires it. It is more than probable he can find some kind of a vessel in the bottom of which holes may be made: a piece of flannel or blanket to lay over the holes, or in lieu of these, some thicknesses of linen, or canvas, or even some hay, straw, or moss; any thing that will support the charcoal, and yet let the water pass through: and he can find a piece of wood, that by burning to a coal, and quenching, will furnish him with charcoal, which he may reduce to powder with a stone, or hammer, in default of a pestle and mortar, or a coffee-mill.

I am, Gentlemen,

Yours, &c.

No. 79, Great Titchfield-street.

JOHN I. HAWKINS.

Recipe for making Family Wine.

By Mr. W. MATTHEWS of Bath.

From the LETTERS and PAPERS of the BATH and WEST
of ENGLAND SOCIETY.

HAVING in the tenth volume of the Society's Papers been indulged with the insertion of a few remarks on the utility of making family wines from several of our garden fruits; I took the liberty of presenting, at a subsequent general meeting, for its examination, a sample of such wine made under my own notice. It will be within the recollection of different gentlemen, who attended that meeting, that the wine they tasted was deemed a very good, pleasant-flavoured, and useful article.

article. The price at which it was made * was considered as small, when compared with the uses to which the wine may be applied, even in genteel families, where economy is regarded. But the idea of making such an article in considerable quantities (especially in abundant fruit years), so as to have the power of furnishing sick and sickly poor persons with such occasional refreshment, could not pass unapproved. The oldest wine of this sort which I now have by me, is yet too young to give proof of that excellence, which three, four, or more years will give it; but it is now so rich and valuable, that I can have no hesitation about publishing the recipe by which it is made, and encouraging any of our members fully to rely upon it for success. The fruits used were of the different sorts mentioned in the recipe, excepting gooseberries, and I think nearly of equal quantities, taken out of a private garden, where they would otherwise have turned to very little account. My friends having fully convinced me, that if I give them white wine equally good with that produced, they will not call on me for foreign white wine, of at least *five* times the price; I have this year taken the advantage of a fine fruit season, and made several hogsheads. If I live to present the Society with a taste of it some years hence, I have no doubt of its being found worthy of their commendation.

I cannot conclude without repeating my recommendation to the owners of gardens in general, to all farmers in easy circumstances, and country gentlemen especially, to regard this useful practice:—and that they may do it

* This will be from 2s. 6d. to 3s. per gallon, according to circumstances.

to the greater advantage, the increased cultivation of the black currant plant seems essential: It is easy of increase, greatly productive, and its fruit, in general, can scarcely form too large a proportion of the mixture.

Recipe.

Take, black currants,
red ditto,
white ditto,
ripe cherries (black hearts are the best),
rasberries, - - - each an equal, or nearly an equal quantity. If the black currants be the most abundant, so much the better.—To 4lb of the mixed fruit, well bruised, put one gallon of clear soft water. Steep three days and nights, in open vessels, frequently stirring up the mass. Then strain through a hair sieve. The remaining pulp press to dryness. Put both liquids together, and to each gallon of the whole put 3lb. good, rich, moist sugar, of a bright yellowish appearance.—Let the whole stand again three days and nights, frequently stirring up as before, after skimming off the top. Then tun it into casks, and let it remain, full and purging at the bung-hole, about two weeks. Lastly, to every 9 gallons put one quart of good brandy, and bung down. If it does not soon drop fine, a stepping of isinglass may be introduced, and stirred into the liquid, in the proportion of about half an ounce to nine gallons.

N. B. Gooseberries, especially the largest, rich-flavoured, may be used in the mixture to great advantage; but it has been found the best way to prepare them separately, by more powerful bruising, or pounding, so as to form the proper consistence in pulp; and by putting six quarts of fruit to one gallon of water, pouring on the water at twice; the smaller quantity at

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80 *An Enquiry into the Causes of the Decay of Wood,*

night, and the larger the next morning.—This process, finished as aforesaid, will make excellent wine, unmixed ; but this fluid, added to the former mixture, will sometimes improve the compound.

An Enquiry into the Causes of the Decay of Wood, and the Means of preventing it. By Dr. PARRY.

From the LETTERS and PAPERS of the BATH and WEST of ENGLAND SOCIETY.

THE power of wood in different forms to supply luxury, to promote science, and to guard and prolong human life, has made the means of preserving it from decay highly interesting to mankind. With this view various premiums have been offered by this and other economical societies. The object of the following discussion is to suggest the best means of prevention, chiefly by inquiring into the nature and sources of the evil against which it is intended to guard.

Wood, when killed by being separated from its root, is subject to gradual destruction from two causes—rotting, and the depredations of insects.

Of the rot there are two supposed kinds, as they affect wood, first, in the open air, or secondly, under cover.

The first is that which in the terms of our premium, Class VII. No. 3, is said to occur to “barn and other out-side-doors, weather-boarding, gates, stiles, and implements of husbandry.” To which, if there were any need of this minute specification, might have been added posts, rails, paling, water-shoots, and various other objects.

The second is well known under the name of the dry-rot, the cause and prevention of which are the subjects of a premium by the Society of Arts in London.

Animal

Animal and vegetable substances possess certain common properties and movements, which constitute what is called life. When that state ceases, and these properties and motions no longer exist, the bodies become subject to the chemical and mechanical laws of all other matter.

When perfectly dry, and in certain degrees of temperature, both seem to be scarcely capable of spontaneous decay. On this principle vast quantities of salmon are annually conveyed in a frozen state to London from the North of England and Scotland; and the inhabitants of the still more Northern regions constantly preserve their food by freezing, unchanged through the longest winters. The gelatinous and other soluble parts of animal substances, when extracted by boiling, and kept in a soft moist state, very readily putrefy. But if the same matter be dried by a gentle heat, and secluded from moisture and air by being kept in bottles or metallic cases, it will remain very long without decay. This is the theory of that well-known and useful substance, portable soup. In the burning climate of Africa, when it is intended to preserve a dead animal for food, all that is necessary is to cut the muscular parts into thin strips, from which, in a few hours, the heat of the sun exhales all moisture, reducing them to a substance like leather or horn, which proves to be unsusceptible of future decay from putrefaction. So also entire human bodies, buried in the arid sands of those countries, have often been found converted by exhalation and absorption of their natural moisture into a dry hard sort of mummy, incapable of any farther change from the agency of those causes, to which, in such situations, they are exposed.

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Similar causes produce the same effects on wood. Even under less rigid circumstances of this kind, as in the roofs and other timber of large buildings, it continues for an astonishing length of time unchanged; witness the timber of that noble edifice Westminster-hall, built by Richard II. in 1397; and the more extraordinary instance quoted by Dr. Darwin, in his ingenious work the *Phytologia*, of the gates of the old St. Peter's church in Rome, which were said to have continued without rotting from the time of the Emperor Constantine to that of Pope Eugene IV. a period of eleven hundred years. On the other hand, wood will remain for ages with little change, when continually immersed in water, or even when deeply buried in the earth; as in the piles and buttresses of bridges, and in various morasses. These latter facts seem to shew that if the access of atmospherical air is not necessary to the decay of wood, it is, at least, highly conducive to it.

In posts fixed in the ground and exposed to the weather, we constantly find that part soonest decay, which is just above or within the ground. So also where there is an accidental hole in an exposed surface, or any artificial cavity, as in a mortise and tenon, or the part where pales nearly touch the rails on which they are nailed, there the wood universally begins first to moulder away. The same thing happens with regard to horizontal rails themselves, which, when made of the same materials, rot much sooner than the pales which they support. These facts are very easily explained. They clearly shew, that the great cause of decay is the constant action of water aided by air, which most affects those points where it is most retained, but has less operation, where, as in the perpendicular pales, it chiefly runs
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off by its own gravity, so that the little which remains is easily and quickly abstracted by the co-operating power of the sun and wind.

The change which I am describing is the consequence of putrefactive fermentation; a chemical operation, in which the component parts of the wood form new combinations among themselves, and with the water which is essential to the process. The precise nature of these new compounds has not been ascertained; but, so far as they are known, consist of certain gases, or species of air, which fly off, and leave behind a powder, consisting chiefly of carbon or charcoal, and the earth which entered into the original composition of the wood.

Besides this chemical change depending on water, that substance tends to destroy wood exposed to the open air by a mechanical operation. Every farmer is acquainted with the power of winter in mouldering down the earth of his fallows. It is equally well known that porous freestone splits and shivers during severe winters. These effects are produced by frost, which, acting on the water in the pores or interstices of these substances, expands it by conversion into ice, and thus bursts the minute cells in which it was contained. There can be no doubt that a similar operation takes place to a certain extent in exposed wood, and thus in some degree promotes its destruction.

It appears, then, that the contact of water and air are the chief causes of the decay of wood. If, therefore, any means can be devised, by which the access of moisture and air can be prevented, the wood is so far secure against decay. This principle may be illustrated by supposing a cylinder of dry wood to be placed in a glass tube or case, which it exactly fills, and the two
ends

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ends of which are, as it is called, hermetically sealed, that is, entirely closed, by uniting the melted sides of each end of the tube. Who will doubt that such a piece of wood might remain in the open air a thousand years unchanged? Or let us take a still more apposite illustration of this fact; that of amber, a native bitumen, or resin, in which a variety of small flies, filaments of vegetables, and others of the most fragile substances, are seen imbedded, having been preserved from decay much longer probably than a thousand years, and with no apparent tendency to change for ten times that period. Let us see then if we cannot, by the exclusion of moisture and air, find means of virtually placing our timber in a case of glass or amber.

With this view, various expedients have been employed, of which the most common is covering the surface with paint; which is oil mixed with some substance capable of giving it the colour which we desire. It is well known that several of the oils, as those of linseed, hempseed, &c. become dry when thinly spread on any hard substance. The drying quality is much assisted by their being previously boiled with certain metallic oxyds, more especially that of lead, litharge. The crust so formed is with difficulty penetrated by moisture or air. For this purpose drying oil is spread on silk or linen, in the manufacture of umbrellas; and will tolerably well succeed in confining hydrogen gas, or inflammable air, in the construction of air-balloons. Hence we see the mode in which the application of paint on wood serves to defend it against the causes of destruction.

When paint is employed within doors, it is customary to add to the oil, besides the colouring matter, some essential oil of turpentine, which not only makes it dry
more

more readily, but, by giving it greater tenuity, causes it to flow more freely from the brush, and therefore to go farther in the work. For the same purposes I observe it forms a part of the paint used on wood and iron work in the open air; but, as it appears to me, most improperly: for I have remarked that on rubbing wood painted white, and long exposed to the weather, the white-lead has come off in a dry powder like whiting; as if the vehicle which glued it to the wood had been decomposed and lost, leaving only the pigment behind: and I have been much inclined to suspect that this has arisen from the oil having been too much *opened*, as the workmen call it, or having its thickness and tenacity too much diminished by a superabundance of the oil or turpentine. In this state it may, in various ways, be more readily acted on by water and air. We know that the properties of what are called unctuous or fat oils are much changed by the admixture of the volatile or essential oils. On this principle we succeed in getting grease out of woollen cloths by oil of turpentine; but whether the same change is produced on the drying oils, I have not learned.

It appears then, that these drying oils either by themselves, or boiled with metallic oxyds, will form a varnish on wood; but it may be questioned how far the colouring matters, with which they are usually mixed, contribute to increase their preservative power. I do not, however, deny that they may be serviceable in this and other views. They might be supposed to enable the oil to lay firmer hold, as it were, on the wood; and they may serve to increase the thickness of the defensive covering. The first of these points is of some importance; for we observe that the paint on street-doors, which

which is become thick by frequent incrustation, is apt, from the strong influence of the summer's sun, to separate from the polished wood beneath, and rise in large blisters; probably in consequence of a greater expansion in the crust itself than in the subjacent wood. Here, therefore, the colouring matter of the paint fails to produce the desired effect; and as to the second end, or that of increasing the thickness of the covering, that may, probably, be much more effectually accomplished than by the bare addition of pigments, some of which are capable of chemical decomposition, and all are costly. This purpose an ingenious artist has of late attempted to answer, by recommending an admixture of road-dust: and for that and other means of reducing the price of paints, has obtained a premium from the London Society of Arts. However just the general principle in this case may be, the application is somewhat unphilosophical; unless it shall be found, which will scarcely be admitted, that dust of every chemical and mechanical quality will equally or sufficiently answer the intended purpose.

Some material of this kind, selected with greater precision, may however undoubtedly be useful; and none I think promises more fairly than siliceous or flinty sand, which, so far as we know, is absolutely indestructible, and which may be easily procured from the sea-shore, and from the currents of the clear rivers and roads in Berkshire and other counties abounding with siliceous stones. Sand from the sea must first be cleared from all saline impregnations by washing in several waters, and any sand may be obtained of the fineness desired, by mixing it with water in a tub, and after having stirred the whole well together, pouring out, in a longer or
shorter

shorter time, the muddy water, from which the sand will settle by its own gravity, in a state fit for use when dried.

More than 30 years ago this subject presented itself to my mind, on seeing some water-shoots which had been pitched and painted in the common way, taken down in a state of complete rottenness. I had read that charcoal buried in the moist earth, had come down to us perfectly sound from the times of the Romans; and that posts long withstood the same moisture, if the part intended to be put into the ground was charred all round to a certain depth. Impressed with these facts, I determined to try an artificial coat of charcoal; and when new water-shoots were constructed, I strongly and carefully rubbed them with a coat of drying oil, which I immediately dredged all over with a thick layer of charcoal finely powdered, and contained in a muslin bag. After two or three days, when the oil was thoroughly dried, and firmly retained the greatest part of the charcoal, I brushed off what was loose, and over that which adhered, I applied a coat of common lead-coloured paint, and a few days after, a second. The whole became a firm and solid crust; after which the shoots were put in their places; and being examined many years afterwards, appeared perfectly sound. Any other colour would probably have succeeded equally well with that which I employed. I do not think that lamp-black, which is a pure species of charcoal, would have answered the purpose of forming a thick defensive covering so well as the grosser charcoal which I used. But whatever sort of charcoal is employed, it ought either to be fresh made, or heated again in close vessels, so as to expel the water which it greedily attracts from the air.

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To all compositions formed from drying vegetable oils there is this objection; that however well they may answer the end proposed, they are too dear for that great consumption, which is usually required for outside work. For this and other reasons, various other substances have been employed for the same purpose.

Of these the most common is pitch, which is well known to be the resinous matter melted by heat of the Pine tribe of trees in form of tar, and afterwards hardened by evaporation. It is applied hot, and when cold, makes a moderately hard varnish. It does not however appear, in fact, to answer the purpose so well as might have been expected. The sun at first melts it, so that it runs off in drops, or adheres to every thing which touches it; and the united influence of air and water seems to make it brittle and powdery like resin. Experience therefore shews it to be of little value. Neither is it probable that its powers would be much improved by admixture with charcoal, sand, or other similar substances. Many members of this Society may recollect its application twenty years ago on the red deal shingled roofs of part of our market. In this case it was used hot, mixed with Spanish brown, and hardened by sand sifted over it with a sieve; notwithstanding which it seems to have left the wood like the unmixed pitch, and, though frequently renewed, has not prevented the necessity of various repairs within these last five years. The original boards are now every where more or less in a state of decay.

The bituminous substance melted by heat out of coal, and commonly called Coal Tar, has been strongly recommended for this purpose by that ingenious philosopher Lord Dundonald. I have tried it largely and unsuccessfully,

fully, though perhaps not fairly; for the workman whom I employed, in order to make it work more easily, added to it oil of turpentine, which certainly diminished its durability by rendering it more miscible with water. I am however inclined to believe that no substance of this kind, used by itself, will become sufficiently dry and hard to resist the influence of the weather.

As animal oils are considerably cheaper than those expressed from vegetables, attempts have been made to communicate to them a drying quality. This has been effected by dissolving in them while hot various substances capable of being melted, in such a portion that the whole mass would become dry and hard when cold. Bees' wax, resin, and brimstone, are found to have this property. Some of them, when united with drying oil, have long been employed for making boots and shoes water-proof, or impervious to moisture*. But they will also succeed when mixed with train oil, which is obtained from the blubber of the whale. In the second Volume of the Memoirs of this Society, printed in the year 1783, there is the following receipt. "Melt twelve ounces of resin in an iron pot or kettle; add three gallons of train oil and three or four rolls of brimstone; and when the resin and brimstone are melted and be-

* For this purpose there is the following receipt by Mr. Barker in Sir John Hawkins's edition of that entertaining work Isaac Walton's Complete Angler, 4th edition, page 229. "Take a pint of linseed-oil, with half a pound of mutton suet, six or eight ounces of bees' wax, and half a pennyworth of resin. Boil all this in a pipkin together; so let it cool till it be milk-warm. Then take a little hair-brush, and lay it on your new boots; but it is best that this stuff be laid on before the boot-maker makes the boots; then brush them once over (with it) after they come from him. As for old boots, you must lay it on when your boots be dry."

come thin, add as much Spanish brown, or red or yellow-oker, or any colour you want, first ground fine with some of the oil, as will give the whole as deep a shade as you like. Then lay it on with a brush as hot and thin as you can. Some days after the first coat is dried, give it a second. It will preserve plank for ages, and keep the weather from driving through brick-work." Page 114.

This composition I tried about 18 years ago on some elm paling, substituting for the colouring matter one or two coats of common white paint for the sake of the appearance. This paling appears to me to be in every part of it which was so covered, as sound as when it was first put up.

As compositions of the resinous kind are apt to crack and become powdery, like the varnish of carriages, by exposure to weather, it is not improbable that this effect may be in some measure counteracted by the mixture of a small portion of bees' wax. Such a compound I have used, but in the quantity of eight ounces to the gallon found it too slow in drying, and capable of being easily scraped off with the nail. Wax is also at this time very scarce and dear *.

* For the information of those who may be inclined to make a trial of these compositions, I have enquired the wholesale prices of the different ingredients of Messrs. Cave and Co. Bristol, from whom I learn that they are very fluctuating, train oil being from 2s. 3d. to 2s. 2d. per gallon; resin from 12 to 21 shillings per cwt.; roll brimstone from 34 to 38 shillings per cwt.; and bees' wax from 3s. 3d. to 3s. 6d. per lb.; the lowest of these prices being about what these articles at present bear.

TO BE CONTINUED IN OUR NEXT.

Intelligence

Intelligence relating to Arts, Manufactures, &c.

(Authentic Communications for this Department of our Work will be thankfully received.)

Report from the Committee on the re-committed Report respecting the Rate of Duty payable on Malt made from Barley of the Growth of England, and from Barley and Bigg of the Growth of Scotland.

*(Ordered to be printed by the HOUSE OF COMMONS,
July 15, 1804.)*

THE Committee having proceeded to the consideration of the matter referred to them, were led to direct their principal attention to the following points:—1. The origin and progress of the duty on malt, and the rates now payable on that article in the two countries; 2. The different sorts of grain liable to the payment thereof; and 3. The rate of duty that ought to be imposed on malt made from barley of the growth of England, and from barley and bigg of the growth of Scotland, respectively.

I. On the Origin and Progress of the Duty on Malt in the two Countries.

Sect. 1. Malt tax in England.—The Committee find that a tax on malt was originally established in England during the troubles in the reign of Charles I.; but it is unnecessary upon the present occasion to trace it farther back than to the year 1697, when by an Act (8 and 9 Will. III. ch. 22.), a duty of sixpence *per* bushel was imposed on malt, and proportional sums on certain liquors,

liquors, as cyder and perry, which might otherwise prevent the consumption of that article. It was at first given for two years and a quarter, but for many years past, it has only been granted from year to year; and hence it is known by the name of "the annual malt tax."

The exigencies of the state, however, soon rendered it necessary to impose heavier duties upon so extensive an article of consumption, and in later times these additional taxes, instead of being temporary, were made permanent, for the purpose of defraying the interest of various loans. The first permanent duty was imposed in 1760 at the rate of three-pence *per* bushel; a further tax of 15 *per cent.* was granted in 1779; and an additional permanent duty of sixpence farthing two-tenths *per* bushel was imposed in 1780. As it became difficult, however to collect these permanent taxes, and to keep the accounts separate, whilst they consisted of such minute fractions, they were consolidated in the year 1787, and one permanent tax to the amount of 9½d *per* bushel was imposed. But the nature of this tax was changed, when the plan for redeeming the land-tax was adopted; for as it became necessary to substitute a sure and productive revenue in lieu of that branch, the above-mentioned permanent tax on malt was among others selected, and ever since it has likewise been annually granted, as a substitute for the annual land-tax. In the year 1802, an addition was made to the former duties on malt to the amount of 1s. 0¼d. *per* bushel, which was of a permanent nature; and in 1803 a further tax at the rate of 2s. *per* bushel was imposed to continue during the present war, and for six months after its conclusion.

The

The following then are the taxes on malt now payable in England, *per* bushel :

	£.	s.	d.
1. Old annual malt tax - - -	0	0	6
2. Annual malt-tax in lieu of land-tax	0	0	9½
3. Permanent malt-tax, 1802 -	0	1	0½
4. Temporary malt-tax, 1803, to continue during the war - - -	0	2	0
Total duties on malt in England	0	4	4

Sect. 2. Malt-tax in Scotland.—It appears to the Committee from a detail given in the appendix, and from the information which Defoe furnishes in his History of the Union, that the Scottish Commissioners, when the treaty was negotiating, struggled earnestly to be totally exempted from any tax on malt. But the difference between the two countries in regard to this important particular, was at last compromised in the following manner; that Scotland should be exempted from the malt-tax during the continuance of the war which then subsisted, after which any further exemption was referred to the Parliament of Great Britain, with this express declaration in the words of the 14th article of the Union: “that it cannot be supposed the Parliament of Great Britain will ever lay any burden, but for the good of the whole, and with due regard to the abilities and circumstances of every part of the United Kingdom.”

In 1713, the annual malt-tax, of sixpence *per* bushel, was first extended to Scotland; but after a trial of twelve years it was thought adviseable in 1725 to reduce it to one-half that sum; and during the whole period, from 1725 to 1802, the malt made in Scotland was only charged one-half of the rates imposed in England. The taxes

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taxes granted in 1802 and 1803, however, were extended over the whole island, with the exception of eight-pence *per* bushel on bigg, which was deducted from the last duty. The taxes on malt, therefore, payable in Scotland, are as follow, *per* bushel :

	£.	s.	d.
1. Old annual malt-tax - - -	0	0	3
2. Annual malt-tax in lieu of land-tax - - -	0	0	4½
3. Permanent malt-tax, 1802 - - -	0	1	0½
4. Temporary malt-tax, 1803, to continue during the war - - -	0	2	0
Total tax on Scotch barley	0	3	8½
Deduct in favour of Scotch bigg 1803	0	0	8
Total tax on Scotch bigg	0	3	0½

Sect. 3. Duties now payable.—The following therefore are the duties on malt, whether made of barley or bigg, now payable in the two countries, *per* bushel :

	£.	s.	d.
On malt made of English barley - - -	0	4	4
On malt made of Scotch barley - - -	0	3	8½
On malt made of Scotch bigg - - -	0	3	0½

Such are the present rates; but it is to be observed that during a period of 77 years prior to 1802, the difference was still greater, Scotch malt paying only one-half of the duty charged on English malt.

II. *Of the different Sorts of Grain liable to the preceding Duties.*

In writings on Natural History, barley is divided into four sorts, but for our present purpose it is only necessary to consider two of them, namely, the two-rowed barley,

barley, and that inferior sort commonly known under the name of bigg or bear.

The two-rowed barley is of so superior a sort, that it is always cultivated where it is possible to raise it with advantage. Its weight is greater, the grains are larger, the husk thinner, and the farina of a more valuable quality, yielding proportionably more spirits, and not only a greater quantity of malt-liquor, but also of a much better flavour.

Bigg, on the other hand, is described as having a much thicker and shorter spike than the two-rowed barley, but at the same time a greater number of grains in an ear or spike, in the proportion of at least from three to two, and often producing even forty-two grains, when common barley has but twenty-two. The ear of bigg is seldom more than two inches in length, it is square, with two rows of grains on two of the sides, and on the other two a single row of grains runs up the middle. In short it is a different species of the same genus.

Bigg, it is well known, from its hardness, and from its not requiring the same quantity of heat, nor the same length of time to ripen it as barley, is peculiarly well calculated for cold and mountainous districts in general; but there are circumstances which render the cultivation of that grain not only proper for, but indispensibly necessary to, very extensive tracts of country in Scotland. In the first place, no other sorts of grain but bigg and oats can be raised in them; and as a rotation of crops is essential for productive husbandry, were the cultivation of bigg to be discouraged, the system of agriculture, the best calculated for that part of the country, would be at once overturned: in the second place, bigg from its being sown later in the season than oats, requiring more

ploughings and a finer tilth, and remaining for a shorter space of time on the ground, and being less affected by wind and rain, is the species of grain by far the best calculated for laying down arable land with sown grasses; hence the artificial herbage, and consequently the improvement of the country, and its means of maintaining live stock, whether for cultivation or food, depends upon the culture of this plant: and in the third place, the raising of bigg is the only means by which the Northern and mountainous districts of Scotland can be protected from the horrors of famine. That grain, from the quickness of its growth, can be reaped in seasons, when even oats have either totally failed, or are greatly damaged by rainy harvests; it furnishes food therefore in those periods of calamity, and with this additional circumstance in its favour, that a mixture of bigg with damaged oats can be converted into meal, which may be made use of in times of scarcity with safety; whereas the meal of such oats without such a mixture could not be used at all, or at least without injuring the health of those who might be compelled to live upon it.

On all these grounds the Committee were impressed not only with the necessity of promoting the cultivation of this species of grain in the Northern or mountainous districts of Scotland, but also with the policy of avoiding as much as possible any measure by which the quantity usually produced is likely to be diminished; and in regard to any difficulty in distinguishing malt made of bigg, from malt made of Scotch or English barley, the Committee refer to the Act of 1803 (43 Geo. III. chap. 145), by which regulations are already provided "for preventing Frauds by making of malt from bear or bigg in Scotland."

III. On the Rate of Duty which ought to be imposed on Malt made from Barley of the Growth of England; and from Barley and Bigg of the Growth of Scotland.

In discussing this important part of the subject, the Committee had two points under their consideration; namely: 1. What was the average price of the barley and bigg produced in the two countries? and 2. Whether that ought to be the sole criterion, according to which the rate of duty ought to be imposed.

For the purpose of obtaining the best information on the subject of the prices of these different sorts of grain, the Committee directed the following accounts to be laid before them; 1. The average prices of English barley, including the barley of Wales, for twelve years, ending 1st January 1804; 2. The average prices of Scotch barley during the same period; and 3. The average prices of Scotch bigg. The results gave £.1. 16s. 11d. as the average price *per* quarter of English barley during that period; £.1. 9s. 8½d. *per* quarter, as the average of Scotch barley; and £.1. 6s. 5½d. *per* quarter, as the average of Scotch bigg, during the same period; being at *per* quarter, / £. s. d.

Difference of price between English barley					
and Scotch barley, on the average of					
twelve years	-	-	-	-	0 7 2½

Difference between English barley and					
Scotch bigg	-	-	-	-	0 10 5½

The difference between these prices, taking the price of English barley as the standard, may be thus stated: Scotch barley is 19½ *per cent.* and Scotch bigg 28½ *per cent.* lower than the average price of the barley of England, including Wales. The Committee however find that the prices of grain, ascertained annually by the

Sheriffs of the different counties of Scotland, under the sanction of a Jury upon oath, (which are known under the name of "the fiars of the year," and are inserted in the Appendix to the Report), are lower than even those above-mentioned. As to bigg in particular, it appears, that for the last twelve years, the average price is £1. 4s. with a small fraction, or 2s. 5d. *per* quarter less than the average resulting from the returns. From an attentive examination of the returns, it appears from the most authentic evidence, that there is a very considerable difference in point of price between the barley of England and of Scotland, and still more between the barley of England and the bigg of Scotland.

The Committee next proceeded to consider whether these prices ought to be accounted the sole criterion, according to which the proportion of duty on these articles ought to be imposed.

Regarding this particular, it occurred that grain of inferior quality requires more trouble and expense to manufacture it, either into spirits or into malt liquor, than where the article is intrinsically more valuable. For instance, 1000 quarters of English barley, at the average price of £1. 16s. 11d. *per* quarter, would be purchased for £1,845. 16s. 8d.; the same sum would purchase 1,395 quarters of bigg, at the average price of that grain, namely, £1. 6s. 5½d. On the supposition that the one would produce as much spirits or malt liquor as the other, yet as more trouble and expense must be required to manufacture 1,395 quarters than 1000, there is no doubt which article the maltster, the distiller, or the brewer, would prefer. It would therefore be unreasonable to impose the same quantum of malt-tax on the 1,395 quarters of bigg, as on the 1000 quarters

ters of barley ; and this observation must have additional force, when it is applied to an article, the cultivation of which, for various reasons already stated, ought in particular districts to be encouraged as much as possible.

On this point, and a variety of other particulars connected with the enquiry, the Committee refer to some very satisfactory evidence given by the Reverend Doctor Skene Keith, which is subjoined in the Appendix to the Report.

Under these circumstances the Committee found it difficult to form an opinion, regarding the exact proportion of duty that ought to be imposed on all the different articles to which this Report relates ; at the same time they have no doubt that there should be a deduction from the two last duties in favour of Scotch bigg, to the amount of one-third thereof. As to Scotch barley, the Committee have stated the facts contained in the Report and the Appendix ; without, however, being able to agree in any conclusive opinion upon the subject.

Before concluding this Report, the Committee think it necessary to take notice of one additional particular, namely, the peculiar state of those remote parts of the kingdom, the Orkney and Shetland Islands, in regard to the tax on malt. On this subject they refer to a memorial printed in the Appendix, stating the inferiority of the grain produced in those islands, and praying for redress. The exposed situation of those remote parts of the Empire certainly requires attention, as it renders their crops so precarious, that even in common years the grain produced is of an inferior quality ; and in 1802 and 1803 had proved so extremely defective, as to induce Parliament to grant relief to their starving inhabitants.

inhabitants. It is stated in the memorial that the taxes on malt were formerly levied in Orkney and Shetland by composition, a system probably originating in the great number and dispersed state of those islands, and that severity of climate, so hostile to the operations of agriculture, with which they have to contend. The Committee cannot give any opinion upon that point; at the same time they beg leave to observe, that it may be well worth enquiring, if a still greater deduction from the duties on malt cannot be admitted in this particular case, whether returning to the old system of composition might not be again resorted to, as better calculated for the situation and circumstances of those islands, and by a saving of expense, prove even more productive, in point of income, than the present mode of levying the duties payable upon malt.

The Committee have thus endeavoured shortly to lay before the House the substance of the information which they have been able to procure, regarding a point of the most essential consequence to the Northern part of the kingdom; and it is of the more importance, as it is in fact the only particular connected with the Union of 1707, which still remains unadjusted. The Committee however trust that Parliament will now be able to settle this interesting subject on just and permanent principles, so as to remove all sources of uneasiness that can arise between the two countries, and to consolidate the Union, which has been so happily established between England and Scotland.

On the whole the Committee came to the following resolutions:

Resolved, That it appears to this Committee, that **bigg** is an inferior species of barley; that it is principally

pally grown in Scotland, in situations improper for the growth of a better sort of grain ; that in ordinary years it is used for the purpose of making malt ; but that in seasons unfavourable to the ripening of oats, it is the chief resource of the inhabitants for food : it is therefore the opinion of this Committee, that it would be impolitic to discourage the cultivation thereof, by imposing the same rate of duty on malt made from that article, as from English or Scotch barley.

Resolved, That it is the opinion of this Committee, that there ought to be a deduction from the duties imposed in 1802 and 1803 in favour of Scotch bigg, to the amount of one-third thereof.

Resolved, That it appears to this Committee, that on an average of twelve years prior to 1804, the barley of Scotland was inferior in point of price to the barley of England, at the rate of 7s. 2½d. *per* quarter, or to the amount of 19½ *per cent.* and the difference in point of duty is at present at the rate of £15. *per cent.*

List of Patents for Inventions, &c.

(Continued from vol. XII. Page 440.)

CHARLES DIBDIN, of Cranford, in the county of Middlesex, Gent. for a method of facilitating the learning of music. Dated April 9, 1808. Specification to be enrolled within one month.

DANIEL DERING MATTHEW, of Upper Marybone-street, in the county of Middlesex, Esq. for certain improvements in the construction of watches and chronometers. Dated April 27, 1808. Specification to be enrolled within one month.

WILLIAM

WILLIAM CHAPMAN, of the town and county of Newcastle-upon-Tyne, Civil Engineer; for his method or methods of conveying coals and other minerals in the working of mines or below ground, and of returning the empty vessels and carriages, so as to save much labour and expense. Dated April 27, 1808. Specification to be enrolled within four months.

WILLIAM BELL, of Birmingham, in the county of Warwick, Engineer; for an improvement in making pipes or pumps for conducting water and other liquids. Dated April 30, 1808. Specification to be enrolled within one month.

EDWARD COLEMAN, Professor of the Veterinary College, in the parish of Saint Pancras, in the county of Middlesex; for certain improvements in the construction and application of a horse-shoe, which will completely prevent several diseases to which the feet of horses are subject, more especially that very general disease called *contraction of the hoof*, and is also particularly adapted for flat convex feet, for horses of cavalry, and for hunting, and for all other purposes where the loss of a shoe is productive of great inconvenience. Dated April 30, 1808. Specification to be enrolled within one month.

THE
REPERTORY
OF
ARTS, MANUFACTURES,
AND
AGRICULTURE.

No. LXXIV. SECOND SERIES. July 1808.

*Specification of the Patent granted to DANIEL DERING
MATHEW, of Upper Mary-le-bone Street, in the Parish
of St. Mary-le-bone, in the County of Middlesex, Esq.;
for certain Improvements in the Construction of Watches
and Chronometers. Dated April 27, 1808.*

With a Plate.

TO all to whom these presents shall come, &c.
Now know YE, that, in compliance with the said proviso,
I the said Daniel Dering Mathew do hereby declare, that
the nature of my said invention, and the manner in
which the same is to be performed, are particularly de-
scribed and ascertained as follows; that is to say: In the
drawings hereunto annexed, Fig. 1, (Plate IV.) repre-
sents (in the manner of a plan) those parts of the struc-
ture of a chronometer which are more immediately em-
ployed in maintaining the vibration of the balance, and are
distinguished by the name of the 'scapement or escape-
ment. The letters *a* A, *b* B, *c* C, *d* D, *e* E, *f* F, indi-
VOL. XIII.—SECOND SERIES. L cate

cate the teeth of two wheels, equal and similar in all respects, which are fixed upon the last arbor of the train ; and the dark-shaded teeth marked by small letters belong to one of the said wheels ; and the light-shaded or outline teeth marked by capital letters belong to the other of the said wheels, and are so placed, that, in the order of rotation, the points or extremities of the teeth of one wheel do respectively stand in or near the middle of the interval between the points or extremities of the teeth of the other wheel ; and the number and figure of the teeth to be made in the said equal and similar wheels may be such as the constructor shall think proper, according to the number of beats he may be desirous of producing in any given portion of time, and the nature of the material out of which he may think fit to make the wheels ; or otherwise a single wheel may be used instead of two, and the teeth be made to stand contrate in the form of pins, or of any other suitable form, as in Fig. 2 ; or otherwise (but not by preference) a single wheel may be used. G and H are the working extremities of two pallets, of which the levers or arms terminate in distinct or separate axes or centres of motion ; but the said axes are nevertheless so disposed, as to cause the motion of the said arms to be concentric with each other, and with the balance itself ; or, in other words, the pallets and the balance do each move in different planes upon one and the same imaginary line or virtual axis. N N is the potence, or piece by which the pallets and the balance are supported. K and L represent back-springs, which urge the pallets towards the wheels (the said pallets being so placed in the potence, that one pallet shall apply itself to one wheel, and the other pallet to the other wheel respectively ; or to the opposite sides and
faccs

faces of a single wheel, if adopted in preference to two wheels as herein-before described); and to each lever there is opposed a stop, which prevents the pallet thereunto belonging from advancing so far as to touch the rim of its correspondent wheel. And the said back-springs may be respectively adjusted, with regard to their strength and action upon the said levers, by means of a screw applied to each, or by setting or bending, or by taking down the thickness thereof, as is well known to artists, and may by their action upon the balance altogether supply the place and office of the spring usually called the pendulum spring. And for the better obtaining and effecting this and other desirable purposes, a compensation for heat and cold may be applied in any of the usual methods unto the said springs, in case the same shall be preferred to a compensation on the balance itself; and the strength and action of the said springs may be regulated, and rendered more equable, in the several angular positions of the levers, by the interposition or use of a part or piece equivalent to the tumbler in a gun-lock, or to the jointed connection between the main-spring and a lever from the axis of the cock, as is sometimes done in the same instrument; both which, as is well known, do alter the action of the said main-spring, and might by a due proportion of the parts be applied (if needful) to equalize the same; and I do so proportion, and apply the said contrivances in some of my said improvements.

And I do make the face of each of my pallets to consist of an inclined plane, as seen in Fig. 1, or more distinctly at *rt* in Fig. 5, ending at *t* in a claw or detent, against which, in the detent H, Fig. 1, the tooth *d* is seen to rest, and prevent the wheel from running down;

and the said inclined planes are made to proceed inwards from the levers towards the wheels or wheel, in the same direction as the said wheels or wheel when at liberty do move. And in order to insure the locking of the tooth upon the claw or detent, so as to prevent the possibility of any trip or disengagement of the wheel at an improper time, I do, when thought needful, make use of a banking-pin fixed to the arm of the inclined pallet, as seen in Fig. 6 at *g*, which keeps the pallet from going farther back than is necessary to allow the tooth to raise up the pallet to its detent by means of the catch *p*, the end or joint of which is a very slender spring. And I do make or form a circular part standing out from the lever of the said catch, against which part the crank of the balance first acts, so as to remove the said catch out of the way of the banking-pin, until it has knocked out the detent, and set the wheel at liberty.

And lastly, I do make the verge or axis of my balance in the form of a crank, as in Fig. 4, in order that the vibration upon its pivots, concentric with the axes of the levers of the pallets, may be performed without any other interruption or action than is intended to be produced by the pallets themselves; and I do so place my balance, that the arm or extreme branch of the said crank shall lie or be disposed between the levers of the said pallets as at *M*. And the action of the said escapement, as delineated in Fig. 1, is as follows: the wheels being urged by the maintaining power to move in the direction marked by the small arrow at *V*, are prevented from revolving by the detent of one of the pallets (for example *H*), which holds against one of the teeth (for example *d*); but, as soon as the balance is by external motion made to vibrate, and its crank *M* comes to drive back

back and displace the lever and pallet H, the wheels become disengaged, and move together, in consequence of which the tooth E, nearest the opposite pallet G, runs along the inclined plane of that pallet, and raises the same, until its detent being opposed to the tooth again stops the rotation; but during this process, the balance will have carried the other pallet H along with it in its semi-vibration on the opposite side, and will be followed by the same pallet in its return, through a longer arc than was employed in the divergence of the said pallet from the line of quiescence, because the said pallet will not in its said return be stopped upon the extremity of a tooth, but will proceed into the space between the teeth *d* and *c*, until it nearly touches the rim of the wheel (being prevented from actual contact by its stop). And as soon as the balance returns to perform its semi-vibration on the side of the pallet G, last raised up by its wheel, it will carry away that pallet, and in like manner disengage the wheels; by the rotation of which, the other pallet H will be again raised. And the alternations will be repeated without limit so long as the motion of the wheels is kept up, because the reaction of the back-springs K and L will be greater in the return of the balance to its first position, than in the other parts of each vibration.

And I do further declare, that my said improvements are capable of being varied, disposed, and applied in and to the construction of watches and chronometers in several different manners, which will readily and without farther instruction be deduced from the preceding descriptions and drawings, by any workman of competent skill in works of this or the like nature; and in particular that the pallets may be both placed on the same
side

side of the wheels or wheel, and the balance may raise them, and receive their maintaining re-action, by means of pallets proceeding from a strait verge, as is shewn in Fig. 3, where the same letters denote the same things, as in Fig. 1, excepting that the letter M shews the pallets of the verge, which in this case is not concentric with the axes of the levers, and upon that and other accounts I do not consider it as being entitled to preference. And farther, that the same materials, workmanship, compensations for temperature in the balance or elsewhere, and other expedients and contrivances for insuring the durability and truth of performance, as are well known and used, and applied in the best chronometers of other constructions, may be also used and applied with and to chronometers, in which my said improvements herein-before set forth and explained shall or may be adopted and introduced, provided that attention be paid to the nature and intention thereof.

And I do farther declare, that I do improve watches and chronometers by stopping the holes with platina, instead of using hard brass or jewelling in movements or the parts thereof wherein my said improvement of stopping with platina may be preferred or required.

In witness whereof, &c.

Specification

Fig. 1.

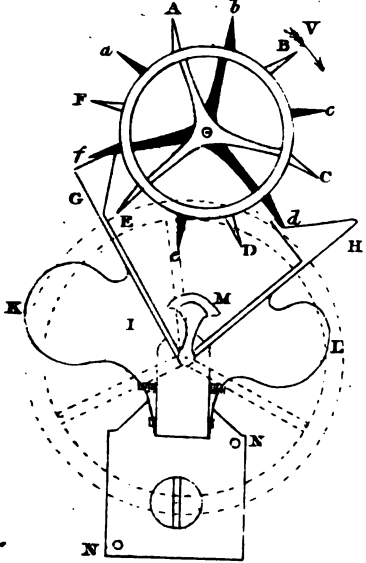


Fig. 3

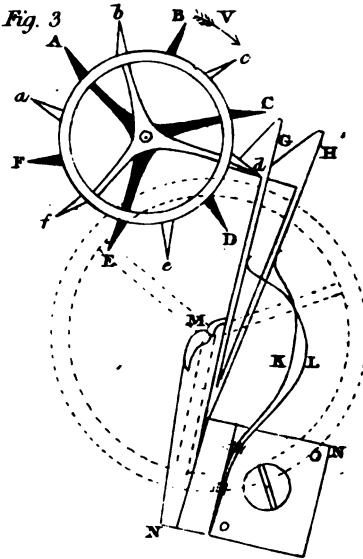


Fig. 2.

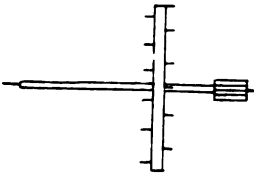


Fig. 4.

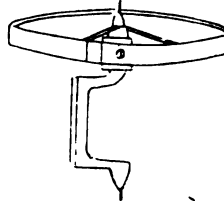


Fig. 5.

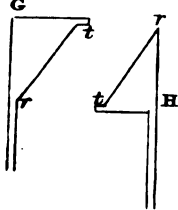
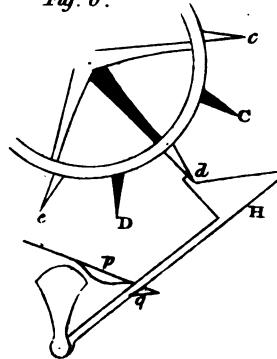


Fig. 6.



Specification of the Patent granted to JOSEPH JEWELL, of Stratford-le-Bow, in the County of Essex, Chemist; for a Method of preparing or reducing to an impalpable Powder, for Medicinal Use, the Substance commonly called or known by the Name of Calomel, whereby the Process employed of levigating the same is rendered unnecessary. Dated November 17, 1807.

TO all to whom these presents shall come, &c.
 NOW KNOW YE, that I the said Joseph Jewell, in pursuance of the said proviso in the said Letters Patent contained, do hereby describe and ascertain the nature of my said invention, and in what manner the same is to be performed, as follows: Calomel or *mercurius dulcis*, as usually prepared, is at first a hard crystalline substance, and requires to be pounded and triturated with water, either in a mortar, or on a slab with a muller, or in a mill; after having been ground or triturated for a considerable time, more water is added, and the whole well stirred up. The finer particles which remain suspended for a short time being poured off with the water into another vessel and left to subside, the water is then decanted, and the fine powder dried for use. The coarser particles are again submitted to the operations of grinding and washing over until the whole be finished. Now the nature of my invention is to produce the effect of the grinding or trituration above described in a more perfect manner during the last sublimation of the calomel, which I do as follows: I take calomel or *mercurius dulcis* broken into small pieces, and put it into an earthen crucible of the form of a long barrel, so as to fill about
 one

one half thereof; I place the crucible on its side in a furnace provided with an opening, through which the mouth of the crucible projects about an inch. I then join to the mouth of the crucible an earthenware receiver, having an opening at its side to receive the open end of the crucible; this receiver is about half filled with water. I lute the joint with a mixture of sand and pipe-clay. The receiver has a cover, which cover has a side continued upwards for containing water, with a chimney or tube in it to allow the escape of steam from water below. I then apply a fire around the crucible sufficient to raise the calomel in vapour, and force it through the mouth of the crucible into the receiver, where by the water while cold, or assisted by the steam when it becomes hot, it is instantly condensed into an impalpable powder. It is proper to wash the product over with water before it is dried, to rid it of any coarser particles which may form about the mouth of the crucible. My patent does not rest upon any particular shape or composition of the apparatus or any part thereof; but that which I claim as my discovery to be secured to me is the rendering of calomel or *mercurius dulcis* fit for medicinal use by a sublimation or distillation so conducted as suddenly to condense the vapours, and prevent the concretion or crystallization of the product; thus rendering trituration, or what is commonly termed levigation, unnecessary.

In witness whereof, &c.

Specification

Specification of the Patent granted to EDWARD WEEKS, of Llaveny Hall, in the Parish of Henlau, in the County of Denbigh, North Wales, Gardener; for a forcing Frame on a new and improved Construction for raising and forcing of Cucumbers, Melons, Strawberries, and various other Fruits and Plants which require the Application of artificial Heat to rear or ripen the same.

Dated March 17, 1808.

With an Engraving.

TO all to whom the presents shall come, &c.
 NOW KNOW YE, that in compliance with the said proviso,
 I the said Edward Weeks do hereby declare, that the
 said invention consists of a double frame of any convenient size or dimensions, made chiefly of wood; the external frame covered with glass-lights, and constructed nearly similar to those in common use; the internal frame placed within the other, not made so deep, and without any covering, with a boarded bottom sufficiently strong for sustaining the weight of the earth or mould which is placed thereon for the growth and sustenance of the plants, and not on the dung or hot-bed as is the general practice; the internal frame is made deep enough to contain the proper quantity of earth or mould only, and the bottom thereof covers a less area than included within the external frame, so that a space or cavity is left of from two to six inches wide, or more at pleasure, between the ends and sides of the two frames for the admission of the heat to the plants, which passes thereto from the hot-bed through such spaces or cavities, and not to the roots of the plants through the earth or mould as in the common way. The internal frame is

so contrived, that by an apparatus hereinafter described, it can with the earth or mould on its bottom and the plants growing thereon, be raised or drawn up altogether within the external frame nearer to the glass-lights, and by that means the plants or fruits may be made to receive a greater and more beneficial influence from the rays of the sun, which is of material benefit and advantage to the growth and sustenance of the plants and to the ripening of the fruits. The internal frame with the earth and plants thereon may also be lowered at pleasure after being so drawn up, and be suspended between the glass and hot-beds, by which more or less heat may be admitted to the plants or fruits. The admission of the heat from the hot-bed through the cavities or spaces between the frames to the plants or fruits, is also a great advantage over the old mode, as it prevents the roots of the plants from being burnt or damaged by the superabundant heat arising from the hot-bed through the earth or mould; and the heat is by the new method admitted to the plants in a more natural way, which much facilitates their growth and the ripening of the fruits thereon.

Fig. 1, (Plate V.) A plan of the two frames. A A A A sides and ends of the external frame; B gutter in front of said frame for carrying off rain-water from the glass-lights, to prevent the same from injuring the lining of dung placed in front of the bed; C, iron spindles placed across the external frame at the junction of each pair of lights under the grooves in which the said lights slide; these spindles turn in iron staples or boxes let into the sides of the external frame, and to one end of each spindle within the said frame is fixed a rack wheel or wheels D, with dogs or stops to each wheel; from each end of the

the said spindles are suspended chains, which chains being fastened to the sides or bottom of the internal frame, the said frame may be raised or lowered at pleasure, by turning round the said spindles with a common winch similar to that used for raising and lowering of a bucket in a well. The internal frame may be also raised and lowered by any other mechanism applicable to the purpose, and the said internal frame may be made in one or more compartments or divisions as occasion may require. E E E E, the ends and sides of the internal frame; F the bottom of the internal frame, with small holes bored therein to drain off the superfluous moisture; G, part of the said spindle, staple or box, rack wheel, dog or stop, and winch, drawn on a larger scale.

Fig. 2, A profile or section of the said frames, shewing the internal frame drawn up within the external one close to the underside of the glass-lights, with the winch, spindle, wheel, and chains.

Fig. 3, Another profile or section of the said frames, describing the internal within the external one resting upon the hot-bed, with the apparatus before-mentioned for raising or lowering the same.

In witness whereof, &c.

Specification of the Patent granted to CHARLES DIBBIN, of Cranford, in the County of Middlesex, Gentleman; for a Method of facilitating the Learning of Music.

Dated April 9, 1808.

With an Engraving.

TO all to whom these presents shall come, &c.
Now KNOW YE, that my method of facilitating the learning of music consists principally in substituting the
M 2 letters

84 *Patent for facilitating the Learning of Music.*

letters of the alphabet for the characters hitherto used for designating the notes named by certain letters of the alphabet, or perhaps it would be better to say in restoring the writing or expressing of music by characters to its original simplicity.

The notes at present used in music are the semi-breve, which is equal to two minims, the minim, which is equal to two crotchets, the crotchet, which is equal to two quavers, the quaver, which is equal to two semi-quavers, and the semi-quaver, which is equal to two demi-semi-quavers.

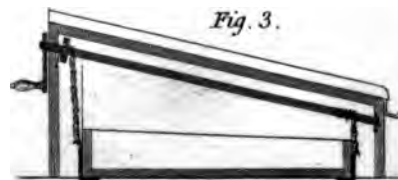
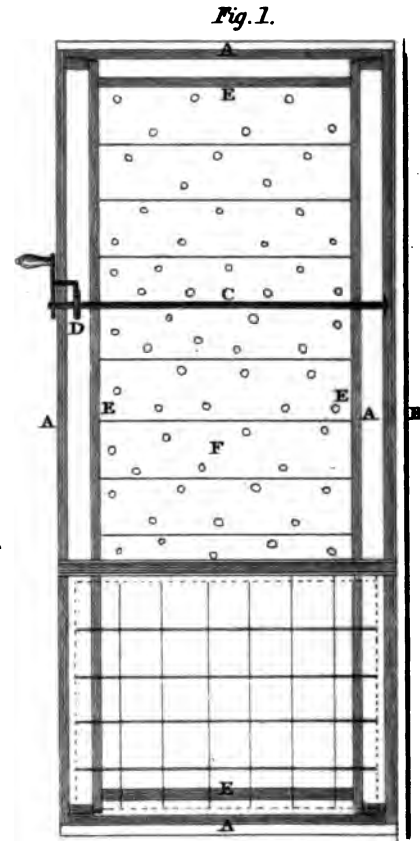
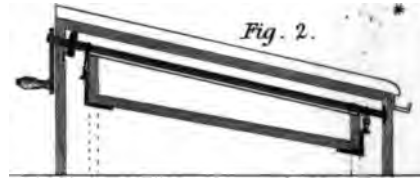
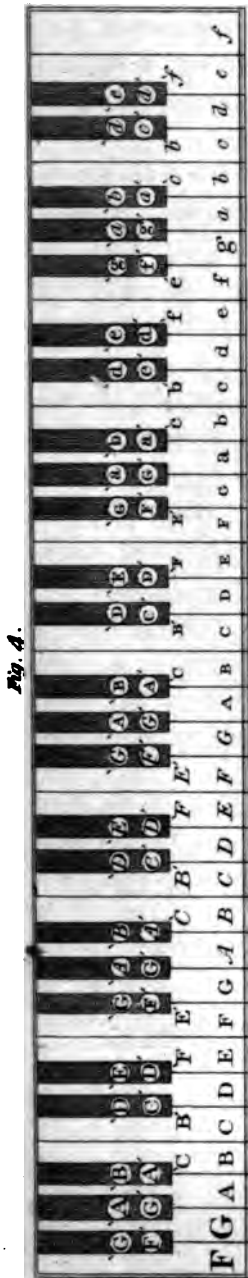
The substitutes intended for these, are the period, the colon, the semi-colon, the comma, the semi-comma, and the demi-semi-comma.

In the present notation, the notes are placed on lines and spaces, and by that means describe the scale, which consists of the first seven letters of the alphabet five times repeated; so that a character must be resorted to to explain a letter.

The substitutes are intended to be the letters themselves, they will completely do away the cliffs, and the following arrangement is what I prefer. The first seven letters are to be large Roman capitals, the second seven large Italic capitals, the third seven small Roman capitals, the fourth seven small, or lower case, Roman, and the fifth seven small Italic.

For the sharp and the flat will be used the acute and the grave accents, and there is no necessity at all for the natural; for, unless a letter be accented, it will be played natural of course.

What are called the bars in music are intended to be called divisions; and, instead of the single and the double bar, it is intended to use an m dash — and a semi-dash.



for an indefinite pause a double m dash =; and for a definite pause a triple m dash ≡. The rest will be represented by points without letters; instead of the repeat will be used an index thus ; in place of the bind, if the distance from letter to letter is short, will be used a hyphen -; and, if long, a half parenthesis (; a slur will also be expressed by a half parenthesis (; a half bracket will be the direction as to how many letters go to a syllable in singing —, and a brace will be placed at the beginning of the lines as it is used for triplets in poetry {.

The time of the air, which at present is marked thus ; C, to signify four crotchets in a bar, now to be called a division, or $\frac{3}{4}$ to signify three minims, or $\frac{4}{4}$ to signify six quavers, &c. are to be ⁴ ; or four semi-colons, ³ : or ⁶ three colons, , or six commas.

The distinctions of measure, as they relate to time, from slow to fast, or as they relate to expression from soft to loud, are intended to be expressed by common English words, as slow for adagio, quick for allegro, soft for piano, loud for forte, &c.

The apogiature, which is signified in common notation by a small note will now be expressed by a small letter, appropriate to the type in which the music is printed, just as the type called English requires long-primer, pica, bourgeois, &c. Various graces will be understood by words instead of marks, such as beat, shake, turn, trill, &c.

EXPLANATION OF THE SCALE. (See Fig. 4. Pl. V.)

On this scale are placed sixty keys, which go on in successional half tones. With the exception of the lower left hand notes F and G, the letters are placed in sevens; the first seven being large Roman capitals, the second seven large Italic capitals, the third seven small Roman capitals, the fourth seven small or lower case Roman, and the fifth seven, or rather six, small Italic. By means of the five-and-twenty short keys the whole scale is so separated that the notes are a half tone from each other. The short keys, which represent the flats and sharps in music, are now to be considered as the grave or acute accents, according to circumstances. To shew this I will describe by way of specimen the seven letters and their appropriate accents, which are distinguished by small Roman capitals. The short key to the right of A is its acute accent; the short key to the left of A is its grave accent; the acute accent of B is C because no short key to the right interferes; the same short key to the left that made the acute accent of A makes the grave accent of B. Our third letter is c, of which the short key to the right is the acute accent, and B itself is the grave accent. D has a regular acute and grave accent right and left. E has its grave accent in the short key to the left, and its acute accent in the letter F to the right, as F has its grave accent in E to the left, and its acute accent in the short key to the right, and G, like D, has its acute and grave accents in the short keys to the right and left.

It is possible to facilitate the learning still more, by pasting printed letters on the keys of the instrument, which would wear off as the pupil became perfect.

Specimen

Specimen of the Manner of writing the Music.

{ 4 G;—C; , e,e,d,c,b,—c; b,a,g; , a,—a; G,F,E,G,c,e,—e; d; ; g;—4,g,f,e,f; g;—
 ; —C; : —C; C; C; —C; C; C; —C; G; ; G;—C; C; D; G;—
 (e; f,d,c,b,a,g,—g,e,f,d,e,c,f,d,—c; b; c; , G,—c; e, e,d,c,b,—d,c; b,a,g; , G;—
 Come join me fellow-subjects all, Like
 C; F; C; F;—E; D; C; F;—G; G; C; : —C; : —C; C; C; ;—
 { a; G,F, E,G,c,e,—e;d; ; G;—c; , e, e,d, c,b,—c; e,d, d; , c,—
 gold my counsel prize, All shall be found who hear my call Rich,
 C; C; C; C; —G; G; G; ;—C; ; G; ; —A; A; B; A;—
 { b; c,a G; F;—G; ; G;—c; , d, e,d, c,b,—a,c, d,e f,e d,c,—
 happy, good, and wise. Wives, children, friends, shall join my cause, I
 G; C; D; D;—G; G; G; ; —C; C; C; E;—F; E; D; F;—
 { b,d e,f,g,c,d,e—G; b; c; G;—c; , d, e,d, c,b,—a,c, d,e, f,e, d,c,—
 sing religion and the laws. ^{Chor.} Wives, children, friends shall join my cause, I
 G,F,E,D,C;—G; C; C; ; —C; C; C; E;—F; E; D; F;—
 { b,d e,f,g,c,d,e,—G; b; c; G;—e,g,f,e,f;—e; f,d,c,b,a,c,—g,e,f,d,e,c,f,d,—c,b; c; ;
 sing religion and the laws.
 G.F.E.D.C.E;—G; G; C; :—C; C; D; G;—C; F; C; F;—F. n. c. n. c. n. c. n.

In witness whereof, &c.

Remarks

*Remarks on a Method of making a Composition for Painting, in Imitation of the ancient Grecian Manner,
By Mrs. HOOKER, of Rottingdean, near Brighton.*

From the TRANSACTIONS of the SOCIETY for the Encouragement of ARTS, MANUFACTURES, and COMMERCE.

The Thanks of the Society were voted to Mrs. HOOKER for this Communication.

I HAD the pleasure to communicate to the Society for the Encouragement of Arts, Manufactures, and Commerce, in 1786, when Miss E. J. Greenland, my method of painting in imitation of the ancient Grecian manner or incaustic painting, and in consequence, they did me the honour to adjudge to me the Gold Pallet, and also afterwards to approve my account of the result of above fifty experiments *per day*, which I made during more than four months in 1792, in the hope of discovering some means of making wax, gum-mastich and water, unite like a cream, in order to expedite the formation of the composition for imitating the incaustic painting, which was published the same year by the Society of Arts. I now take the liberty of sending them another copy, but with some alterations and many additions, which I trust will be found calculated to facilitate and improve that method of painting, as they have arisen from much observation and reflection on several pictures I have painted since I had last the honour of addressing the Society. In consequence of the application of several gentlemen of the profession, I have drawn up this paper, which considering the former attentions of the Society, I thought it would be proper for me to offer first to them
for

for their acceptance, but if they should not think it worthy of communication, I hope they will pardon the intrusion, and attribute it only to the sense of gratitude I feel for the honour already conferred.

Method of preparing and applying a Composition for Painting in Imitation of the ancient Grecian Manner.

Put into a glazed earthen vessel, four ounces and a half of gum arabic, and eight ounces, or half a pint (wine measure) of cold spring-water; when the gum is dissolved, stir in seven ounces of gum-mastich, which has been washed, dried, picked, and beaten fine. Set the earthen vessel containing the gum-water, and gum-mastich, over a slow fire, continually stirring and beating them hard with a spoon, in order to dissolve the gum-mastich; when sufficiently boiled, it will no longer appear transparent, but will become opaque, and stiff, like a paste. As soon as this is the case, and that the gum-water and mastich are quite boiling, without taking them off the fire, add five ounces of white-wax, broken into small pieces, stirring and beating the different ingredients together, till the wax is perfectly melted and has boiled. Then take the composition off the fire, as boiling it longer than necessary would only harden the wax, and prevent its mixing so well afterwards with water. When the composition is taken off the fire, and in the glazed earthen vessel, it should be beaten hard; and whilst hot (but not boiling) mix with it by degrees a pint (wine measure) or sixteen ounces more of cold spring-water; then strain the composition, as some dirt will boil out of the gum-mastich, and put it into bottles: the composition, if properly made, should

30 *Composition for painting in the Grecian Manner.*

be like a cream, and the colours when mixed with it, as smooth as with oil. The method of using it, is to mix with the composition upon an earthen pallet, such colours in powder as are used in painting with oil, and such a quantity of the composition to be mixed with the colours as to render them of the usual consistency of oil colours; then paint with fair water. The colours when mixed with the composition may be laid on either thick or thin, as may best suit your subject, on which account this composition is very advantageous, where any particular transparency of colouring is required; but in most cases it answers best, if the colours be laid on thick, and they require the same use of the brush, as if painting with body colours, and the same brushes as used in oil-painting. The colours if grown dry, when mixed with the composition, may be used by putting a little fair water over them; but it is less trouble to put some water when the colours are observed to be growing dry. In painting with this composition the colours blend without difficulty when wet, and even when dry the tints may easily be united by means of a brush and a very small quantity of fair water. When the painting is finished, put some white wax into a glazed earthen vessel over a slow fire, and when melted, but not boiling, with a hard brush cover the painting with the wax, and when cold take a moderately hot iron, such as is used for ironing linen, and so cold as not to hiss, if touched with any thing wet, and draw it lightly over the wax. The painting will appear as if under a cloud till the wax is perfectly cold, as also, whatever the picture is painted upon is quite cold; but if, when so, the painting should not appear sufficiently clear, it may be held before the fire,

fire, so far from it as to melt the wax but slowly; or the wax may be melted by holding a hot poker at such a distance as to melt it gently, especially such parts of the picture as should not appear sufficiently transparent or brilliant; for the oftener heat is applied to the picture, the greater will be the transparency and brilliancy of colouring; but the contrary effect would be produced if too sudden or too great a degree of heat was applied, or for too long a time, as it would draw the wax too much to the surface, and might likewise crack the paint. Should the coat of wax put over the painting when finished, appear in any part uneven; it may be remedied by drawing a moderately hot iron over it again as before-mentioned, or even by scraping the wax with a knife: and should the wax by too great or too long an application of heat form into bubbles at particular places, by applying a poker heated, or even a tobacco-pipe made hot, the bubbles would subside; or such defects may be removed by drawing any thing hard over the wax, which would close any small cavities.

When the picture is cold, rub it with a fine linen cloth. Paintings may be executed in this manner upon wood (having first pieces of wood let in behind, across the grain of the wood to prevent its warping), canvass, card, or plaster of Paris. The plaster of Paris would require no other preparation than mixing some fine plaster of Paris in powder with cold water the thickness of a cream; then put it on a looking-glass, having first made a frame of bees-wax on the looking-glass the form and thickness you would wish the plaster of Paris to be of, and when dry take it off, and there will be a very smooth surface to paint upon. Wood and canvas are best covered with some grey tint mixed with the

92 *Composition for painting in the Grecian Manner.*

same composition of gum-arabic, gum-mastich, and wax, and of the same sort of colours as before-mentioned, before the design is begun in order to cover the grain of the wood or the threads of the canvass. Paintings may also be done in the same manner with only gum-water and gum-mastich, prepared the same way as the mastich and wax; but instead of putting seven ounces of mastich, and when boiling, adding five ounces of wax, mix twelve ounces of gum-mastich with the gum-water, prepared as mentioned in the first part of this receipt: before it is put on the fire, and when sufficiently boiled and beaten, and is a little cold, stir in by degrees twelve ounces, or three quarters of a pint, (wine measure) of cold spring water, and afterwards strain it. It would be equally practicable painting with wax alone, dissolved in gum-water in the following manner. Take twelve ounces or three quarters of a pint, wine measure, of cold spring-water, and four ounces and a half of gum-arabic, put them into a glazed earthen vessel, and when the gum is dissolved, add eight ounces of white wax. Put the earthen vessel with the gum-water and wax upon a slow fire, and stir them till the wax is dissolved and has boiled a few minutes: then take them off the fire and throw them into a basin, as by remaining in the hot earthen vessel the wax would become rather hard; beat the gum-water and wax till quite cold. As there is but a small proportion of water in comparison to the quantity of gum and wax, it would be necessary in mixing this composition with the colours, to put also some fair water. Should the composition be so made as to occasion the ingredients to separate in the bottle, it will become equally serviceable if shaken before used to mix with the colours.

I had

I had lately an opportunity of discovering that the composition which had remained in a bottle since the year 1792, in which time it had grown dry and become as solid a substance as wax, returned to a cream-like consistence, and became again in as proper a state to mix with colours, as when it was first made, by putting a little cold water upon it, and suffering it to remain on a short time. I also lately found some of the mixture composed of only gum-arabic water and gum-mastich, of which I sent a specimen to the Society of Arts in 1792; it was become dry, and had much the appearance and consistency of horn. I found, on letting some cold water remain over it, that it became as fit for painting with, as when the composition was first prepared.

An Enquiry into the Causes of the Decay of Wood, and the Means of preventing it. By Dr. PARRY.

(Concluded from Page 60.)

ALL the substances contained in these mixtures are capable of perfect incorporation with each other by heat, and when separately exposed, are with great difficulty acted on by water or air in any heat which occurs in our climate. They should be applied hot with a common painter's brush on the wood which is previously very dry, so as to sink deeply into its pores; and though at first they are apparently somewhat greasy when cold, yet after some days they make a firm varnish, which does not come off on rubbing. When it is required to give beauty to the work, colouring matters may either be added to the mixture, or afterwards applied over it in form of common paint. Two coats of the composition should

should always be given ; and in all compound machinery, the separate parts should be so varnished before they are put together ; after which it will be prudent to give a third coating to the joints, or to any other part which is peculiarly exposed to the action of moisture, such as water-shoots, flood-gates, the beds of carts, the tops of posts and rails, and all timber which is near or within the ground. Each coat should be dry before the parts are joined, or the last coat applied.

These compositions are equally efficacious in keeping iron from decay by rusting. They might also be very advantageously employed in rendering water-tight the plaster which is used to case the outside of the arches of vaults unsheltered by roofs, provided the mortar were made perfectly dry, and the covering of the arch brought up to an angle thus



instead of making it follow the form of the arch in an ellipse or the segment of a circle.



It is necessary to mention that compositions made of hot oil should for the sake of security be heated in metallic or glazed earthen vessels in the open air. For whenever oil is brought to the boiling point, or 600° of Fahrenheit's thermometer, the vapour immediately catches fire, although not in contact with any flame ; and though a lower degree of temperature than that of boiling should be used in this process, it is not always practicable either exactly to regulate the heat, or to prevent the overflowing of the materials ; in either of which

which cases, were the melting performed in a house, the most fatal accidents might follow.

The following is the proportion of the above ingredients, and the mode of mixing them, which I should recommend.

Take 12 ounces of resin, and 8 ounces of roll brimstone, each coarsely powdered, and 3 gallons of train-oil. Heat them slowly, gradually adding 4 ounces of bees'-wax, cut in small bits. Frequently stir the liquor, which, as soon as the solid ingredients are dissolved, will be fit for use. What remains unused will become solid on cooling, and may be remelted on subsequent occasions.

If the addition of charcoal powder or siliceous sand contributes to the durability of drying oil, it may probably have a similar effect on this composition; but whether it may be best to mix them with the ingredients, or apply them afterwards, I cannot from experience tell. In the latter case, the powder should be sifted on, while the first coat of the composition is still hot; and, after some days, when that is dry, should have a brush gently passed over it, in order to remove all the particles which do not adhere; after which other coats of the composition may be applied, as before directed.

This is all which occurs to me as to the mode of preserving wood when exposed to the weather.

When wood decays under cover, that condition is usually called the dry-rot. Let us examine the circumstances in which this change takes place.

It affects the interior doors, shelves, laths which subdivide the layers of wine, and all other wood work in certain cellars; beams and rafters which support the roofs of close passages; joists lying on or near the earth;

earth ; the wainscoating of large rooms, little inhabited, in old and especially single houses ; and wood in various other situations of a similar kind, which need not be particularized. In some of these cases, while one sample or portion of wood shall suffer the dry rot, another specimen or portion shall remain unchanged. In other instances, wood of various kinds and qualities has been successively employed, and all has alike suffered. During the stages of change, a crop of mucor or mould, and very frequently of fungi, has sprung from the porous mass ; and the decay is always attended with a wide-spreading exhalation, the odour of which cannot well be described, but which is sufficiently known.

What then are the causes of this destruction ? Precisely the same as those which I have before described ; though their action is differently modified, and less obvious to gross observation. The decay is produced by the putrefactive fermentation of the component parts of the wood, in connection with moisture, without which, as I have before stated, wood cannot putrefy.

Common air is not only capable of mixing with a considerable quantity of water in form of vapour, but during every state of our atmosphere is always much loaded with it. Water becomes vapour in consequence of being united with a certain proportion of that substance which is called heat. If a sufficiently cold substance comes in contact with vapour, the superabundant heat, which was necessary to its existence in that form, passes into that cold substance, and the vapour is then immediately condensed or changed into water. Thus, if in the hottest day in summer, when the vapour in our breath is totally invisible, we breathe on a looking-glass or plate of polished metal, which is colder than our
breath,

breath, the surface is immediately dimmed; and if we continue to breathe on it, small drops of liquid appear, which gradually become larger and larger, and many of which at length uniting, run down the surface in a stream. The same thing takes place on the outside of a glass of water drawn in summer from a deep well, and of a bottle brought up into a warm room out of a cool cellar; and on the inside of our windows in frosty weather. On the other hand, we could not dim with our breath a plate of metal or glass of 100 degrees of heat, which is greater than that of our breath, and no mist is observable on the inside of our windows during the heat of a summer's day; nor is there any condensation of moisture on the outside of a glass of cold water fresh drawn from the well, or of a bottle out of a cellar, when either is brought into the open frosty air.

These circumstances will explain many appearances, by which, for want of due examination, we are often greatly puzzled. We are frequently mortified by seeing in our houses, especially in the country, the walls become stained, or the paper separated and hanging down, and often perishing; and as this usually happens on the side or corner which is most exposed to the weather, we conclude that the damp comes through the wall, and tax our faculties to the utmost in order to prevent this penetration. The measures which we employ sometimes succeed. But it often happens that casing and plastering and painting the devoted angle fails; and then, as the last resource, we take off the paper and attach it to canvas at the distance of one or more inches from the wall, and thus, for the present at least, effect the desired purpose. Now in this case it is just as absurd to suppose that the wet comes through the wall, as

that it comes through the glass window in a frosty day, or the glass or bottle from the well or cellar. The fact is, that in an exposed house, and more especially on the most exposed corner of a room seldom warmed by fire, the inner surface of the wall, by the continuance of frost, is become of a very low temperature, like the air within the room itself. So long as this state of equal temperature between the wall and internal air continues, or if the wall is warmer than that air, it is obvious that the vapour which is mixed with the air cannot part with any heat to the wall, and, therefore, will not undergo condensation; just as no dampness appears on our windows during a hot day in summer. But if a thaw comes on, and the air becomes warmer than the wall, which, from its capacity of easily shifting place, it will readily do, then the vapour which is mixed with it parts with its superabundant heat to the colder wall, and appears on it in moisture or drops, or pours down it in streams; just as happens to the cold bottle brought into the warm dining-room.

This change is the greater, the more completely the materials of the wall fit it for carrying the heat out of the vapour, or, in philosophical language, the better they conduct heat. Hence a wall painted in oil condenses vapour, or runs with water, sooner than one, which, being unpainted, is more porous; for which reason, in cities, we first perceive dampness and drops or streamlets of water on the oil-painted party walls which bound our staircases, and which are, therefore, absurdly said to sweat, though these walls have no communication with the outward air, and, from their varnished covering, cannot admit of the passage of moisture or perspiration through their pores.

In

In this case the remedy is obvious, and by its success shews the nature of the evil. Prevent your walls from ever becoming colder than the warmest external air of winter, and you will never have this appearance of damp on their inner surfaces.

This may be done, first, by constructing the walls of such a degree of thickness, or with such a disposition or quality of materials, that they shall not, in the usual way, be greatly cooled throughout their whole substance by any temperature of the outward air. With this view, I think that in all single houses, which are not warmed by neighbouring fires, and more especially in situations exposed to high winds, and therefore to great evaporation from the external surface, and consequent abstraction of heat, the walls should always be double, having on the inside a thin layer of brick, with an interval of one or two inches from the outer and thicker layer of brick or stone, to which it must be united by proper binders. The porous structure of the bricks, added to the impermeableness of the intermediate stratum of air, would so ill conduct heat, that such walls would necessarily tend to keep a house dry and warm in the winter, as well as cool in the summer. This end would be still further promoted by filling the interval between the two layers with dry sand, fresh sifted coal-ashes, or powdered charcoal. In fact, when the common external means before described have succeeded in curing dampness, it has been either by affording a varnish, which has diminished evaporation by preventing absorption, or by increasing the space or changing the quality of the materials of the wall through which the heat was to pass, so as in either of these cases to retain it more forcibly: and when the dampness has been remedied by removing the

paper to some distance from the wall by means of strained canvass, that effect has been produced by rendering the paper a worse conductor of heat; and therefore indisposing it to condense the vapour in the room so readily as when it was in contact with the colder wall.

It has been suggested, that it would be possible to keep out cold, or, in more accurate language, prevent the egress of heat from the inside of a room, and therefore from the walls surrounding it, by shutting it closely up, and preventing any admission of the cold external air. This has arisen from the supposition that air is not a good conductor or transmitter of heat through its substance or pores, but that it merely carries it by changing place with some other portion which was less charged with it. If there were no other mode of abstracting the heat from the walls of a room, and if it were possible wholly to prevent any change of its air, this theory might perhaps apply. But it is not possible to prevent some exchange of this kind through the atmosphere of any habitable chamber; and it is evident from the moisture being most abundantly, or perhaps solely, deposited on the inside of that part of the wall which is most exposed to the external cold, that the chief or common mode in which the wall is cooled is not by the access of cold air into the room, but by the passage of heat from the wall itself into the cold air without. We may, however, so far avail ourselves of this principle, as to exclude as much cold air as we can, by shutting up the windows and chimnies of uninhabited rooms during the severity of frost.

It may farther be suggested, that as, during a thaw, the air, being warmer than in frost, has a greater quantity of water in form of vapour mixed with it, shutting
up

up a room on such occasions may, by retarding the admission of warmer air so charged with vapour, allow time for the walls to acquire an equable temperature through their substance from without, so as to anticipate any condensation on their surface which might occur from the free admission of the external air. To this I only answer, as before, that rooms according to the common construction cannot be excluded from communication with the external air; and that, in fact, the dampness does under these circumstances take place, though the doors and windows are never opened.

In all cases, however, there is one method of preventing this species of dampness, which is infallible; and that is to keep every part of the internal surface of the wall in the chamber or staircase sufficiently warm by good fires. With this view all staircases ought to have some means of receiving artificial warmth.

If, notwithstanding this and the former precaution, a wall should accidentally become damp, the next best expedient is to dry it as quickly as possible by a free current of warm air.

This discussion, which at first sight might appear tedious and irrelevant, will, I trust, no longer be thought so, when it shall have been found necessary for the establishment of a principle on the subject more immediately before us.

In order to shew the analogy, let us take the simplest example, which is that of a wainscoated room, unwarmed by fires. When the wainscoat is colder than the air, it condenses the vapour in form of moisture. If that moisture were exposed to the influence of the sun and wind, the case would come under the former head of decay, which is that of wood wetted by rain in the open

open air. The water soon evaporates, and little decay proceeds in the wood. So in the wainscoat, the surface next the room, though unprotected by paint, will perhaps be long in rotting, because the room admits of currents of air, more especially when doors and windows are frequently opened, so as to evaporate the superficial moisture, though less quickly and effectually than in the open air. But what is the case with the surface of the pannel next the wall? The air, loaded with moisture, penetrates into that interstitial space, and deposits it by condensation on that surface. But there is afterwards no current of air to evaporate the water so deposited, which then slowly decomposes and destroys that surface of the pannel. Such is precisely the process of the dry-rot, which always begins next the wall, and gradually proceeds to the painted or outer surface of the wood. It resembles in its chief circumstances the decay of paper in a damp room; and it precisely resembles that of paper projecting from the wall on canvass, which will still often happen, if the wall be subject to acquire a very considerable degree of coldness, though much more slowly than in the former case.

The same process obtains in all other cases. Whenever the wood is cooler than the air which it touches, the vapour is condensed upon it; and being exposed to no new heat or current of air sufficient again to evaporate it, remains till another fit of condensation affords a new supply.

Thus the process of corrosion and decomposition is continually supported, till the wood moulders away.

The term *dry-rot* is, therefore, so far from being expressive of the real fact, that decay proceeds under these circumstances more quickly than in the open air, pre-
cisely

cisely because the wood is more constantly and uniformly wet; just as the lower parts of posts and rails, and any cavities in timber exposed to the weather, rot sooner than those parts which readily and speedily dry.

The smell which we perceive on going into vaults or cellars, where this process is going on, arises partly from the extrication of certain gases, mingled perhaps with some volatile oil, and partly from the effluvia of those vegetable substances, which have already been said to grow on it; and which, though they begin merely because the decayed wood is their proper soil, yet afterwards tend probably to the more speedy decomposition of the wood itself. They cannot, however, with more propriety be said to be the cause of the dry-rot, than the white clover, which appears on certain lands after a top-dressing of coal-ashes, can be said to have produced the soil on which it flourished.

I have remarked above, that sometimes only a particular sort or sample of timber has in certain situations rotted, while another piece has continued for a great length of time perfectly sound. Hence persons have been deceived, and been disposed to attribute the dry-rot solely and universally to some original peculiarity in the wood itself. Dr. Darwin explains this fact by telling us, that the wood so decaying has probably been cut in the spring, when the sap in the alburnum was not only abundant, but of a saccharine quality; which, in combination with the vegeto-animal substance or gluten, disposes it to run with unusual readiness into destructive fermentation. In some trees, as by more particular custom the oak, the bark is a very valuable article of commerce, and is found not only to quit the tree more readily, but to contain a larger proportion of

tan in the spring, when the sap is rising, than at other seasons. Hence an old Act of Parliament, now in force, ordains that all oak, except for the purpose of building, shall be felled in the spring. Whether doors, posts and rails, paling, barrel-staves, &c. come under the denomination of building, it may be difficult to say; but it seems at first view highly to be lamented that any law should impose an obligation to destroy a valuable species of property. It would indeed be matter of peculiar regret, if an impolitic and avaricious spirit should induce the owners of oak forests to extend the same principle to the timber employed in the construction of great machines, and more especially the British navy.

Various means have been employed in order to remove the tendency to the dry-rot in trees so felled. Thus they have been long exposed to the rain, or steeped, or even sometimes boiled in water, and then dried by artificial heat. These means do not however appear to have been successful in entirely washing out the fermentible sap, which therefore makes them much more subject to the decay of which we are treating. It may however still be doubted whether it acts in any other way than by furnishing a disposition, which requires to be called into action by the same cause which operates in all other cases, moisture.

In proof of what I have stated, I have been informed by one of our Vice-Presidents, that in a large vat or set of vats for beer, belonging to him, the staves formed of oak $2\frac{1}{2}$ inches thick, notwithstanding they were previously steeped in hot water, and then thoroughly dried, in a very short time underwent the dry-rot, while others in the same situation continued unchanged five or ten times that period. It is highly worthy of remark, that the

the outside of these staves, which was painted, continued sound, and that the decay began on the inside, where, from the vats being at different times more or less filled, they were subject to the joint and successive influence of moisture and air.

I have mentioned above, that the putrefactive fermentation cannot take place except in certain temperatures, the lowest of which, according to Thompson, must be but little below 45 degrees of Fahrenheit's thermometer, and the highest within the degree which produces dryness by evaporation. The temperature most conducive to this effect has not, so far as I know, been ascertained, though much useful information on this head might be obtained from a set of well-conducted experiments.

The following then appears to be the whole theory of the dry-rot; that it is a more or less rapid decomposition of the substance of wood, from moisture deposited on it by condensation, to the action of which it is more disposed in certain situations than in others; and that this moisture operates most quickly on wood which most abounds with the saccharine or fermentable principles of the sap. Let us see how this theory corresponds with the best known means of prevention, and what more effectual measures it may suggest.

The first point is certainly to choose timber properly felled and well dried. And here, in order to prevent the injudicious fall of large oak timber, it may be of some consequence to know that the bark of such timber contains much less tan than that of the younger and more succulent wood; and that this principle, together with the proper extractive matter, is considerably more abundant in the bark of the Leicester or Huntingdon willow, than

in that of any oak. According to the experiments of Mr. Davy, $7\frac{1}{2}$ pounds of the former will go as far in tanning leather as 9 or 10 lbs. of the latter. It has however been asserted, that if an oak, or any other tree, which is stripped of its bark, be suffered to stand two or three years before it is felled, the wood will have acquired a very great degree of strength and durability.

Next, where it is practicable, a current of air should be frequently made to pass along the surface of the wood. This expedient seems to have been particularly attended to by the ingenious architects of our Gothic churches, who are said with that view to have left various openings in the walls between the two roofs of those edifices. In order also to promote evaporation, a certain degree of heat, such as that of air heated by the sun or fire, should, if possible, be from time to time applied. Cellars themselves ought to have some communication with the outward air by means of windows and shutters, or trap-doors: and that these may be for a short time opened in proper weather, so as to have a draught of air; and that no very low degree of temperature is necessary for the preservation of fermented liquors, provided that temperature be uniform, is evident from the practicability of keeping wine extremely well in cellars which are not damp, and in which, therefore, one or both of these circumstances must have taken place.

The destruction of wainscoating may be long deferred by keeping in the apartment suitable fires.

Lastly, the dry-rot may in all cases be infallibly prevented where it is practicable to cover the surface of the wood, properly dried, with a varnish which is impenetrable

trable and indestructible by water. With this view two or three coats of the composition before described should be laid on the dry wood, before it is erected or put together, and a third or fourth after it is put in its place; and proper means should be taken thoroughly to dry each successive coat of varnish. In situations of this kind, what means of preservation are necessary must be employed at first; as it seems scarcely possible to renew them on fixed timber with any chance of benefit.

I do not know whether in very damp situations, surrounded with stagnant air, these varnishes would in time admit of the growth of fungi or mould. The brimstone might be supposed sufficient to preclude that effect; but, if we believe Braconnot, seeds of the white mustard sown in pure flower of brimstone, and well watered, became vigorous plants, which flowered and produced effective seed. It is certain, however, that the essential oil of turpentine will act as a poison on growing vegetables; and perhaps the same property may exist in resin, which seems to be a similar essential oil, united with a certain proportion of oxygen.

It is however highly probable that the union of the brimstone may have another good effect, which is to prevent one of the causes of the destruction of timber which I have before mentioned, the depredations of insects. Whoever would learn the havoc which certain animals of this kind are capable of making in hot countries, would do well to read Smeathman's description of the Termes, or White Ant, originally published in the Philosophical Transactions, and from thence abridged into the English Encyclopedia Britannica, and other collections. In this country we know little of such ravages.

Mischief however of this kind does sometimes occur, and may be the work of various animals, a particular account of which may be met with in the fifth volume of the Transactions of the Linnæan Society.

I am informed, that, in India, a circle of Lord Dundonald's coal-tar drawn on the floor round boxes and other furniture, will effectually preserve them and their contents from the depredations of the white ant.

It appears that most insects are fond of sugar and mucilage; which is the probable reason why that wood is most subject to be penetrated by worms, which is felled when it most abounds with sap. In such cases, it might be well to try the effects of washing the wood, previously to the use of the varnish, with a solution of arsenic in hot water, in the proportion of 1 lb. to 10 gallons; or with a strong decoction of coloquintida or bitter apple, or white hellebore: after which the wood must be compleatly dried before the application of the varnish in the manner before directed. All these preparations are extremely cheap, and are either destructive or offensive to insects, and therefore will, probably, be an effectual defence against any injury from that cause.

Circus, Sept. 30, 1807.

C. H. PARRY.

*On the Cultivation of the Poppy.**By T. COGAN, M. D.*

From the LETTERS and PAPERS of the BATH and WEST
of ENGLAND SOCIETY.

GENTLEMEN,

ALTHOUGH the ardour with which the British nation pursues whatever promises to be of public utility, is perhaps unequalled by any other, and certainly exceeded by none; yet there is one subject which has hitherto been permitted to escape our attention, and in which several nations upon the continent can not only boast of their superior policy, but are already enjoying considerable advantages from it; I mean *the cultivation of the poppy to a great extent for the benefit of its oil, as an article of food*, and for other useful purposes.

It will doubtless be remarked, that we ought not to ascribe the neglect of it as an article of food to *inattention* altogether, but to a superior caution, as the narcotic quality of the poppy renders it totally unfit to be taken inwardly. This, it is allowed, is, in appearance, a very formidable objection; and as it respects the lives of multitudes, it ought not to be treated with levity: the objection itself, and the argument from analogy on which it is founded, ought to be completely confuted, before the article can be recommended to the community in this novel point of view.

We might observe that the objection is solely founded upon very slight and imperfect analogy. It *assumes* that, because some parts of a plant are noxious, the whole must be equally noxious. But this assumption may be confuted in numberless instances. Daily experience

perience testifies that different parts of plants possess not only different, but *opposite* qualities. Oranges and lemons, which are used in profusion, possess juices that are both palatable and refrigerating; but these are inclosed in a rind, the essential oil of which is extremely acrid and stimulating: and it is well known that the bland and nutritive tapioca is the produce of a tree whose roots are highly poisonous. In this case, therefore, the argument from analogy may be considered as a very proper motive for *caution*; but, if it advances farther, it degenerates into a pernicious *prejudice*.

There have been, however, many incidental circumstances which have had a partial influence in removing these prejudices. It is well known that compounders of medicine have made a very liberal use of the seeds of poppies, as substitutes for the oil of sweet almonds, without the least detriment to the patient. They have sometimes imputed to it *additional virtues*, from its being supposed to possess narcotic properties. But that they have erred in their hypothesis is plain, from the practice of many individuals who have made the seeds of poppies a common article of food*.

But it will be the principal object of the following paper to inform the inhabitants of this country, through the medium of your publication, that the above objection has been repeatedly advanced and repeatedly confuted; that experiments, first made with a degree of caution, have finally removed prejudices long and inveterate; and that the white poppy (*papaver hortense semine albo*) is cultivated to a very great extent in

* See Prosper Alpinus, lib. iv. cap. i. Geoffrey Mat. Med. tom. ii. p. 715. Lewis's Materia Medica, article *Papava Album*.

France, Brabant, and Germany, and more recently in *Holland*, chiefly to extract the oil from its seeds ; which is found not only to be salubrious, but to be peculiarly delicate in its flavour. It is now become a considerable article of commerce : the oil of a superior quality, for the use of the table, and the inferior for manufactories and various other purposes. It is produced not only with considerable profit to the cultivator, but also to the merchant and consumer.

As it is natural to imagine that the prejudices against the common use of poppy oil for culinary purposes, will be very general, since they are apparently sanctioned by prudent caution, it is not expected that the most positive assertions, founded upon the experience of strangers on the continent, would be sufficient to remove them. But a circumstantial narrative of a contest which has already taken place ; and of the final triumph of experience over the opposition founded on analogous reasoning ; and a particular statement of the advantages which have accrued to the cultivator, merchant, and consumer, may perhaps attract the attention of some agriculturists in our own country, who may thus be encouraged to make similar experiments : and as the issue must be the same, they will be able to produce absolute demonstration that the oil is totally destitute of the noxious qualities that have been ascribed to it ; and finally convince the public that it may become a cheap and useful substitute for the olive oil, and a very beneficial article of commerce.

For this purpose I shall state to the agriculturist a succinct account of the rise and progress of the cultivation of the poppy, in order to express the oil from the seed ; the manner of cultivating it, and the emoluments which

which have been received by the cultivator, from authentic documents in the Dutch and German languages which are in my possession.

In the year 1798, the Society established at Amsterdam for the encouragement of agriculture, being informed that the oil of poppies was cultivated in several parts of *France*, *Flanders*, and *Brabant*, thought it an object of sufficient importance to make more particular inquiry; and they learned from indubitable authority, not only that it was generally used in the place of olive oil, but that several thousand casks of it were exported annually, a large quantity of which was imported into *Holland*, and sold under the name of olive oil, or mixed with it in considerable abundance; and they appealed to several merchants who were members of the Society for the truth of this assertion, without being contradicted.

These facts induced the Society to propose three premiums, consisting of a *silver medal* and *ten ducats* each, which were divided into the three following classes:

The *first* to the husbandman who should sow not less than half an acre of a *clayey* soil with poppy seed; the *second* on a sandy ground; and the *third* on turf or peat land.

They also offered to the person who shall have cultivated the largest quantity of ground, on the two first species of soil, in the most masterly and advantageous manner, a *gold medal*, value *fifty ducats*, or that sum in money, in lieu of the above premiums.

The candidates were to give an accurate statement of the quantity of seed sown *per* acre; the time of sowing, and of gathering the poppies; the quality of the soil; the manner of procedure in every part of the process; the

the quantity of oil produced, and the total of the expences.

In consequence of the above proposals, in the year following (1799) Mr. P. Haak became a claimant; sent in satisfactory specimens of the oil produced, accompanied with testimonials from two respectable physicians; that upon experiments made, it fully appeared that the use of the oil was not in the least prejudicial to the human constitution; and that the oil-cakes were very wholesome and nutritive food for cattle.

The Committee appointed to receive this report, not only expressed their entire satisfaction at the attestations of the physicians, but they laid before the Society at large an account of the proceedings which had taken place in France, upon the interesting question concerning the noxious or salubrious qualities of the poppy-oil, in the following *Narrative*.

So early as in the beginning of the seventeenth century, the oil of poppies was produced in such large quantities, that it gave rise to great and lasting contentions, which rose to such a height, that the government was desired to interfere, and appease the contending parties, either by authorizing the use of this oil, or totally to prohibit the consumption, according as experiments should decide whether it contained the noxious qualities ascribed to it, or not.

The opposers urged the objections already stated: they asserted, that as the capsulum or poppy-head contained juices highly narcotic, this must also be the case with its seeds; that the frequent use of the oil extracted from them exposed the consumer to all the dangerous consequences arising from the too liberal use of opiates; and that they would finally obtund the faculties of the

soul; that the oil was of a drying quality, for that it was upon this account it became peculiarly useful to painters: they therefore implored government to confine its uses to this object.

The *advocates* maintained that no proofs existed of these pernicious effects; on the contrary, experience testified that the seeds were peculiarly nutritive both to men and cattle; they asserted that the ancient Romans, concerning whose mental powers there could be no doubt, were accustomed to mix the oil and meal of the poppy-seed with honey, and have it served up as a second course at their tables; and that it was on account of its nutritious qualities so well known to the Romans, that Virgil gives it the title of *vescum*, food, by way of pre-eminence; and that the peculiar qualities of this oil rendered it a desirable object of cultivation; that its taste was delicate and pleasant, somewhat resembling that of the hazel nut; that it continued in a fluid state, exposed to a much greater degree of cold than was required to congeal the olive-oil; that it contained a larger quantity of *fixed air*, which preserved it a longer time from being rancid; that in these particulars it not only approached to the finest oil of *Provence*, but it mitigated the disagreeable taste which that oil acquired by length of time; and that the poppy-oil decidedly deserved a preference to every other oil expressed from seeds, whether nut, almond, or beech; which, though they yielded large quantities, soon became rancid: and as there was no appearance of its being pernicious in the more extensive use of it, so valuable a product ought not to be confined within the narrow bounds of the painter's use.

Things

Things were in this state, without any prospect of accommodation between the parties, when the severe winter of 1709 overtook the combatants. This damaged the *olive*, *nut*, and *almond* trees to such a degree, that there was a great scarcity of their oils; and they were obliged to have recourse to the substitutes, beech and rape, &c. But it was soon perceived that these were far inferior to the oils extracted from the red, white, or brown poppy, which had a much nearer resemblance to the small portion of the olive-oil which the winter had spared. This was consequently mixed with the olive-oil in the proportions of $\frac{1}{4}$, $\frac{1}{3}$, $\frac{1}{2}$, without the least opposition. But when it was attempted to sell the poppy-oil in its pure and unmixed state, the opposition became so violent, that the Lieutenant-General of the police of Paris resolved, in the year 1717, to order the medical faculty of that city to make the strictest examination concerning this subject, and deliver in their report.

The faculty appointed *forty* of the most celebrated practitioners in medicine as a committee of enquiry, who were witnesses to various experiments accurately made, and whose report was expressed in the following terms: "*cum sensuissent doctores, nihil narcotici, aut sanitati inimici in se continere, ipsius usum tolerandum esse existimarent*;" that is, they were of opinion, that as there is nothing narcotic or prejudicial to health contained in the oil, the use of it might be permitted.

But this decision was unsatisfactory; and popular clamours determined the court of justice to pass a decree in the year 1718, whereby the sale of poppy-oil, whether mixed or unmixed, was prohibited, under a fine of three thousand livres for the first offence. Notwithstanding this prohibition, the sale of the article was

clandestinely encouraged and gradually increased until the year 1735, when the court issued a severer decree, enjoining it upon superintendants appointed, to mix a certain quantity of the *extract of turpentine* to every cask containing 1100 lbs. of this oil; of which not less than two thousand casks were consumed in Paris alone. This attempt to render the use of it impracticable, had no other influence than to annihilate the public sale of the article, but the secret demand for it increased: till at length, in the year 1773, a society of agriculture undertook to examine with the closest attention all that had been alleged, either by writing or otherways, for or against the general use of this oil. Experiments were repeated in the presence of the most distinguished chemists, with the same result, and the Society presented a petition to the Minister of Police, setting forth the great advantages that would accrue both to commerce and agriculture, by reversing the prohibition.

This petition was put into the hands of persons who vended various kinds of drugs, and who had, as a body, opposed the subject of it, with orders to state all their objections to the *medical faculty*; by these means the faculty became masters of every thing that was urged in the debate. They again made several experiments in the year 1776, and finally confirmed the decree of the faculty issued in 1717, declaring that the oil of poppies was not injurious to health; that it did not contain a narcotic power, and that it might be recommended to general use with the utmost safety. The medical faculty at Lisle had also made a similar declaration in the year 1773. From that time to the present the cultivation of the poppy has not met with any formidable opposition; and has increased to such a degree both in France and
Brabant,

Brabant, that they have been able to export a considerable surplus, to the great advantage of the husbandman, as well as the merchant; and in seasons of scarcity it has been found of the most essential service, in all cases where the use of oils was required. In the Northern parts of France, it was used by soap-boilers, as a substitute for other oils, which were extremely dear: and in Brabant the oil-cakes are constantly used as food for cattle with obvious benefit.

These facts being established, the Committee of Agriculture in Amsterdam proposed the premiums above-mentioned, in order to ascertain whether the experiments made would authorize the cultivation of the article upon a large scale; whether the soil and climate of Holland were beneficial to its growth; whether the quantity or quality of the oil would be similar to the product of France and Brabant; whether the profits would indemnify the husbandman from giving it the preference to other crops; whether the oils could be afforded cheaper than those in common use; and to what purposes either in the arts or manufactures it might be applied.

Deeming it possible that the narrative of a contest which subsisted the greater part of a century, and in which the advocates for the internal use of the poppy-oil were uniformly triumphant, may have some influence in destroying our own prejudices and apprehensions, respecting the pernicious quality of this oil, I shall now proceed to state, in as concise a manner as perspicuity will permit, the most interesting particulars respecting its culture, selected from various foreign publications upon the subject.

Soil. The poppy may be cultivated with success on various kinds of soil. It has been tried on a rich black soil, peat-ground, and sandy heath, and been productive. Those lands in which the wild poppy abounds the most, are obviously most congenial to its nature. The richer the soil, and the clearer from weeds, the larger will be the crop. It is not so advisable, however, to manure for the poppy, as for the crop preceding it, as it is more exposed to injury by weeds. Hence it succeeds the best after carrots, cabbage, potatoes, &c. The land was generally prepared by the spade, as in planting potatoes; and the finer it is worked the greater the advantage. But when it is cultivated to a great extent, they use the plough. The seed has generally been sown broad-cast, the plants thinned, and weeded afterwards, as in the culture of turnips; but in drills it is sown about six or eight inches distant in the rows, which has been strongly recommended; experiments upon a small scale having manifested a superiority in this mode.

The kind and quantity of seed. Although the white poppy has been chiefly used in France and Brabant, under the supposition that it produced the finest oil, yet it has been found that various other kinds will answer the purpose as well. It is even asserted that the blue poppy, while it yields the largest quantity of seed, is in no respect inferior in the quality of the oil. Admiral Kinsbergen, whose private virtues render him no less a favourite with his countrymen, than his skill and courage as a naval officer, instituted an experiment with different kinds of seeds in the same soil, and he could not perceive any difference in the quality of the oil, while the seeds of the blue poppy yielded considerably more.

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The quantity of seed generally used in the broad-cast has been after the rate of 2 lbs. to an English acre. In drills a lesser proportion has been used.

Time of sowing. This is from the middle of March to the middle of April. If it be sown much earlier, it is more likely to be choked by weeds; if later, the harvest will be thrown deep into the autumn; and unless the weather be unusually favourable, the seeds will not ripen kindly.

Weeding. As soon as the plants appear about two inches above the ground, they must be carefully weeded and thinned, till they stand about seven or eight inches from each other. The weeding to be repeated as often as it shall appear necessary.

TO BE CONCLUDED IN OUR NEXT.

An Experiment on Soap-Suds as a Manure.

By Mr. G. IRWIN, of Taunton; with Remarks by the

Rev. THOMAS FALCONER.

From the LETTERS and PAPERS of the BATH and WEST
of ENGLAND SOCIETY.

A FEW years ago my attention was attracted by the soil of a garden, reduced to a state of poverty, very unfriendly to vegetation. Interest in its future produce influenced my wishes for its restoration. An invigorating manure was necessary; but such a stimulus could not be easily procured. While considering which of the succedanea within my reach had the greatest probable appearance of succeeding, it occurred, that possibly some trivial advantage might be derived from the oil and alkali suspended in the waters of a washing. Pits were immediately

diately ordered to be made, and in them the contents of a tub, which my servant usually committed to the common sewer, were carefully deposited: as washing succeeded washing, other pits were dug and filled; so that the whole garden, a small portion only excepted, has in this manner been watered and enriched: that small portion remains a visible demonstration of the utility of this manure. There vegetation is still languid; while the residue of the garden, invigorated by the suds only, annually exhibits a luxuriance almost equal to any thing this fertile neighbourhood can produce.

Remarks, by the Rev. T. FALCONER.

1. The above important experiment may perhaps remind the reader of the principal ingredients of the oil compost, suggested by Dr. Hunter of York. In the simple fluid manure we have an animal oil, potash, and water; in the compost are the same oil and the same alkali, but neither of them perhaps in so pure a state as in the manure, with the addition of "fresh horse-dung." The fresh horse-dung is added, in order to produce "heat and fermentation;" and a delay of "six months" is supposed to be necessary, to make the compost "fit for use." All, however, that seems to be gained by the horse-dung is the animal oil, which may be united to the alkali during the process of fermentation, the straw, which in the fermentation of the compost will bind the mass together, and when decomposed on the ground, will afford a small supply of vegetable matter. If we make the comparison strictly accurate on the other side, we may observe, that in the fluid manure there must be an increased quantity of animal matter in the water, after it has been used for the purpose of washing linen.

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The experiment then shews what is the advantage of the application of the oil and alkali only, as a manure; and perhaps the delay of "six months" in preparing the compost would not be compensated by any superior efficacy that may be expected to arise from the combination of the horse-dung.

It also appears from the experiment, that the compost is a more useful discovery than Dr. Hunter himself could justly infer from his own limited experience of its effects.

2. This mixture of an oil and an alkali has been more generally known than adopted, as a remedy against the insects which infest wall fruit-trees. It will dislodge and destroy the insects, which have already formed their nests and bred among the leaves. When used in the early part of the year, it seems to prevent the insects from settling upon them; but whether by rendering the surface of the leaf disagreeable to the bodies of the animals, and thus repelling them, or by neutralizing the acid they deposit, and thus preventing the leaf from contracting into a necessary form for their reception; I cannot presume to determine. One of the modes by which this mixture indirectly contributes to the fertility of the ground, may be by its destruction of the insects which prey upon the plants.

It is also, I think, to be preferred to the lime-water, or the wood-ashes and lime; which Mr. Forsyth recommends to be used for the removal of insects. It is preferable to the lime-water and the lime, because lime loses its causticity, and with that its efficacy, by exposure to air, and must consequently be frequently applied; and to the dredging the leaves with the fine dust of wood-ashes and lime, because the same effect is produced by

the mixture without the same labour, and is obtained without expense.

Mr. Speechley, in his treatise on the Vine, published in 1796, has used this mixture with great success; but he has applied it awkwardly and wastefully. He directs it to be poured from a ladder out of "a watering-pot over both trees and wall, beginning at the top of the wall, and bringing it on in courses from top to bottom." Page 161. Mr. Speechley is not the first person who has thought of this application of the mixture. It is a fact which has been long known and neglected.

A considerable extent of wall may be washed by means of a common garden-pump in a short time; and this operation should be repeated as often as a supply of the mixture can be procured; or if the water of a washing cannot be had, a quantity of potash of commerce dissolved in water may be substituted*. The washing of the trees and wall twice a week for three or four weeks in the spring will be sufficient to secure them from the injuries of these insects.

On the whole, then, this must be considered as a valuable manure, as it can be obtained easily, at small expense, and in large quantities; and when its nature is well understood, will probably be no less esteemed by the farmer than horse-dung. To the gardener, as well as to the former, it is useful, mixed with mould, as a fertilizing compost; or when fluid may be applied to his fruit-walls, as a wash fatal to the noxious brood of predatory insects.

* Mr. Speechley uses his mixture warm to soak the shreds, and wash the wall more effectually.

The Bakerian Lecture, on some new Phenomena of chemical Changes produced by Electricity, particularly the Decomposition of the fixed Alkalies, and the Exhibition of the new Substances which constitute their Bases; and on the general Nature of alkaline Bodies.

By HUMPHRY DAVY, Esq. Sec. R. S. M. R. I. A.

From the TRANSACTIONS of the PHILOSOPHICAL SOCIETY
of LONDON.

I. Introduction.

IN the Bakerian Lecture which I had the honour of presenting to the Royal Society last year, I described a number of decompositions and chemical changes produced in substances of known composition by electricity, and I ventured to conclude, from the general principles on which the phenomena were capable of being explained, that the new methods of investigation promised to lead to a more intimate knowledge than had hitherto been obtained, concerning the true elements of bodies.

This conjecture, then sanctioned only by strong analogies, I am now happy to be able to support by some conclusive facts. In the course of a laborious experimental application of the powers of electro-chemical analysis, to bodies which have appeared simple when examined by common chemical agents, or which at least have never been decomposed, it has been my good fortune to obtain new and singular results.

Such of the series of experiments as are in a tolerably mature state, and capable of being arranged in a connected order, I shall detail in the following sections; particularly those which demonstrate the decomposition and composition of the fixed alkalies, and the production

of the new and extraordinary bodies which constitute their bases.

In speaking of novel methods of investigation, I shall not fear to be minute. When the common means of chemical research have been employed, I shall mention only results. A historical detail of the progress of the investigation, of all the difficulties that occurred, and of the manner in which they were overcome, and of all the manipulations employed, would far exceed the limits assigned to this Lecture. It is proper to state, however, that when general facts are mentioned, they are such only as have been deduced from processes carefully performed, and often repeated.

II. *On the Methods used for the Decomposition of the fixed Alkalies.*

The researches I had made on the decomposition of acids, and of alkaline and earthy neutral compounds, proved that the powers of electrical decomposition were proportional to the strength of the opposite electricities in the circuit, and to the conducting power and degree of concentration of the materials employed.

In the first attempts that I made on the decomposition of the fixed alkalies, I acted upon aqueous solutions of potash and soda, saturated at common temperatures, by the highest electrical power I could command, and which was produced by a combination of VOLTAIC batteries belonging to the Royal Institution, containing 24 plates of copper and zinc of 12 inches square, 100 plates of 6 inches, and 150 of 4 inches square, charged with solutions of alum and nitrous acid; but in these cases, though there was a high intensity of action, the water of the solutions alone was affected, and hydrogen and ox-
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ygen disengaged with the production of much heat and violent effervescence.

The presence of water appearing thus to prevent any decomposition, I used potash in igneous fusion. By means of a stream of oxygen gas from a gasometer applied to the flame of a spirit lamp, which was thrown on a platina spoon containing potash, this alkali was kept for some minutes in a strong red heat, and in a state of perfect fluidity. The spoon was preserved in communication with the positive side of the battery of the power of 100 of 6 inches, highly charged; and the connection from the negative side was made by a platina wire.

By this arrangement some brilliant phenomena were produced. The potash appeared a conductor in a high degree, and as long as the communication was preserved, a most intense light was exhibited at the negative wire, and a column of flame, which seemed to be owing to the developement of combustibile matter, arose from the point of contact.

When the order was changed, so that the platina spoon was made negative, a vivid and constant light appeared at the opposite point: there was no effect of inflammation round it; but aëriform globules, which inflamed in the atmosphere, rose through the potash.

The platina, as might have been expected, was considerably acted upon; and in the cases when it had been negative, in the highest degree.

The alkali was apparently dry in this experiment; and it seemed probable that the inflammable matter arose from its decomposition. The residual potash was unaltered; it contained indeed a number of dark grey metallic particles, but these proved to be derived from the platina.

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I tried several experiments on the electrization of potash rendered fluid by heat, with the hopes of being able to collect the combustible matter, but without success; and I only attained my object, by employing electricity as the common agent for fusion and decomposition.

Though potash, perfectly dried by ignition, is a non-conductor, yet it is rendered a conductor by a very slight addition of moisture, which does not perceptibly destroy its aggregation; and in this state it readily fuses and decomposes by strong electrical powers.

A small piece of pure potash, which had been exposed for a few seconds to the atmosphere, so as to give conducting power to the surface, was placed upon an insulated disc of platina, connected with the negative side of the battery of the power of 250 of 6 and 4, in a state of intense activity; and a platina wire, communicating with the positive side, was brought in contact with the upper surface of the alkali. The whole apparatus was in the open atmosphere.

Under these circumstances a vivid action was soon observed to take place. The potash began to fuse at both its points of electrization. There was a violent effervescence at the upper surface; at the lower, or negative surface, there was no liberation of elastic fluid; but small globules, having a high metallic lustre, and being precisely similar in visible characters to quicksilver, appeared; some of which burnt with explosion and bright flame as soon as they were formed, and others remained, and were merely tarnished, and finally covered by a white film, which formed on their surfaces.

These globules numerous experiments soon shewed to be the substance I was in search of, and a peculiar inflammable principle the basis of potash. I found that
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the platina was in no way connected with the result, except as the medium for exhibiting the electrical powers of decomposition; and a substance of the same kind was produced when pieces of copper, silver, gold, plumbago, or even charcoal, were employed for completing the circuit.

The phenomenon was independent of the presence of air; I found that it took place when the alkali was in the vacuum of an exhausted receiver.

The substance was likewise produced from potash fused by means of a lamp, in glass tubes confined by mercury, and furnished with hermetically inserted platina wires, by which the electrical action was transmitted. But this operation could not be carried on for any considerable time; the glass was rapidly dissolved by the action of the alkali, and this substance soon penetrated through the body of the tube.

Soda, when acted upon in the same manner as potash, exhibited an analogous result; but the decomposition demanded greater intensity of action in the batteries, or the alkali was required to be in much thinner and smaller pieces. With the battery of 100 of 6 inches in full activity I obtained good results from pieces of potash weighing from 40 to 70 grains, and of a thickness which made the distance of the electrified metallic surfaces nearly a quarter of an inch; but with a similar power it was impossible to produce the effects of decomposition on pieces of soda of more than 15 or 20 grains in weight, and that only when the distance between the wires was about one-eighth or one-tenth of an inch.

The substance produced from potash remained fluid at the temperature of the atmosphere at the time of its production; that from soda, which was fluid in the degree

gree of heat of the alkali during its formation, became solid on cooling, and appeared having the lustre of silver.

When the power of 250 was used, with a very high charge for the decomposition of soda, the globules often burst at the moment of their formation, and sometimes violently exploded and separated into smaller globules, which flew with great velocity through the air in a state of vivid combustion, producing a beautiful effect of continued jets of fire.

III. *Theory of the Decomposition of the fixed Alkalies; their Composition, and Production.*

As in all decompositions of compound substances which I had previously examined, at the same time that combustible bases were developed at the negative surface in the electrical circuit, oxygen was produced, and evolved or carried into combination at the positive surface, it was reasonable to conclude that this substance was generated in a similar manner by the electrical action upon the alkalies; and a number of experiments made above mercury, with the apparatus for excluding external air, proved that this was the case.

When solid potash, or soda in its conducting state, was included in glass tubes furnished with electrified platina wires, the new substances were generated at the negative surfaces; the gas given out at the other surface proved by the most delicate examination to be pure oxygen; and unless an excess of water was present, no gas was evolved from the negative surface.

In the synthetical experiments, a perfect coincidence likewise will be found.

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I mentioned that the metallic lustre of the substance from potash immediately became destroyed in the atmosphere, and that a white crust formed upon it. This crust I soon found to be pure potash, which immediately deliquesced, and new quantities were formed, which in their turn attracted moisture from the atmosphere till the whole globule disappeared, and assumed the form of a saturated solution of potash *.

When globules were placed in appropriate tubes containing common air or oxygen gas confined by mercury, an absorption of oxygen took place; a crust of alkali instantly formed upon the globule; but from the want of moisture for its solution the process stopped, the interior being defended from the action of the gas.

With the substance from soda, the appearances and effects were analogous.

When the substances were strongly heated, confined in given portions of oxygen, a rapid combustion with a brilliant white flame was produced, and the metallic globules were found converted into a white and solid mass, which in the case of the substance from potash was found to be potash, and in the case of that from soda, soda.

Oxygen gas was absorbed in this operation, and nothing emitted which affected the purity of the residual air.

* Water likewise is decomposed in the process. We shall hereafter see that the bases of the fixed alkalies act upon this substance with greater energy than any other known bodies. The minute theory of the oxydation of the bases of the alkalies in the free air, is this: oxygen gas is first attracted by them, and alkali formed. This alkali speedily absorbs water. This water is again decomposed. Hence, during the conversion of a globule into alkaline solution, there is a constant and rapid disengagement of small quantities of gas.

The alkalies produced were apparently dry, or at least contained no more moisture than might well be conceived to exist in the oxygen gas absorbed; and their weights considerably exceeded those of the combustible matters consumed.

The processes on which these conclusions are founded will be fully described hereafter, when the minute details which are necessary will be explained, and the proportions of oxygen, and of the respective inflammable substances which enter into union to form the fixed alkalies, will be given.

It appears then, that in these facts there is the same evidence for the decomposition of potash and soda into oxygen and two peculiar substances, as there is for the decomposition of sulphuric and phosphoric acids and the metallic oxyds into oxygen and their respective combustible bases.

In the analytical experiments, no substances capable of decomposition are present but the alkalies and a minute portion of moisture; which seems in no other way essential to the result than in rendering them conductors at the surface: for the new substances are not generated till the interior, which is dry, begins to be fused; they explode when in rising through the fused alkali they come in contact with the heated moistened surface; they cannot be produced from crystallized alkalies, which contain much water; and the effect produced by the electrization of ignited potash, which contains no sensible quantity of water, confirms the opinion of their formation independently of the presence of this substance.

The combustible bases of the fixed alkalies seem to be repelled as other combustible substances, by positively electrified

electrified surfaces, and attracted by negatively electrified surfaces, and the oxygen follows the contrary order*; or the oxygen being naturally possessed of the negative energy, and the bases of the positive, do not remain in combination when either of them is brought into an electrical state opposite to its natural one. In the synthesis, on the contrary, the natural energies or attractions come in equilibrium with each other; and when these are in a low state at common temperatures, a slow combination is effected; but when they are exalted by heat, a rapid union is the result; and as in other like cases with the production of fire.—A number of circumstances relating to the agencies of the bases of the alkalies will be immediately stated, and will be found to offer confirmations of these general conclusions.

IV. On the Properties and Nature of the Basis of Potash.

After I had detected the bases of the fixed alkalies, I had considerable difficulty to preserve and confine them so as to examine their properties, and submit them to experiments; for, like the *alkahests* imagined by the alchemists, they acted more or less upon almost every body to which they were exposed.

The fluid substance amongst all those I have tried, on which I find they have least effect, is recently distilled naphtha.—In this material, when excluded from the air, they remain for many days without considerably changing, and their physical properties may be easily examined in the atmosphere when they are covered by a thin film of it.

The basis of potash at 60° Fahrenheit, the temperature in which I first examined it, appeared, as I have

* See Bakerian Lecture 1806, page 28, Phil. Trans. for 1807...

already mentioned, in small globules possessing the metallic lustre, opacity, and general appearance of mercury; so that when a globule of mercury was placed near a globule of the peculiar substance, it was not possible to detect a difference by the eye.

At 60° Fahrenheit it is however only imperfectly fluid, for it does not readily run into a globule when its shape is altered; at 70° it becomes more fluid; and at 100° its fluidity is perfect, so that different globules may be easily made to run into one. At 50° Fahrenheit it becomes a soft and malleable solid, which has the lustre of polished silver; and at about the freezing point of water it becomes harder and brittle, and when broken in fragments, exhibits a crystallized texture, which in the microscope seems composed of beautiful facets of a perfect whiteness and high metallic splendour.

To be converted into vapour, it requires a temperature approaching that of the red heat; and when the experiment is conducted under proper circumstances, it is found unaltered after distillation.

It is a perfect conductor of electricity. When a spark from the Voltaic battery of 100 of 6 inches is taken upon a large globule in the atmosphere, the light is green, and combustion takes place at the point of contact only. When a small globule is used, it is completely dissipated with explosion accompanied by a most vivid flame, into alkaline fumes.

It is an excellent conductor of heat.

Resembling the metals in all these sensible properties, it is however remarkably different from any of them in specific gravity; I found that it rose to the surface of naphtha distilled from petroleum, and of which the specific gravity was 861, and it did not sink in double distilled

tified naphtha, the specific gravity of which was about 770, that of water being considered as 1. The small quantities in which it is produced by the highest electrical powers, rendered it very difficult to determine this quality with minute precision. I endeavoured to gain approximations on the subject by comparing the weights of perfectly equal globules of the basis of potash and mercury. I used the very delicate balance of the Royal Institution, which when loaded with the quantities I employed, and of which the mercury never exceeded ten grains, is sensible at least to the $\frac{1}{1000}$ of a grain. Taking the mean of 4 experiments, conducted with great care, its specific gravity at 62° Fahrenheit, is to that of mercury as 10 to 223, which gives a proportion to that of water nearly as 6 to 10; so that it is the lightest fluid body known. In its solid form it is a little heavier, but even in this state when cooled to 40° Fahrenheit, it swims in the double distilled naphtha.

The chemical relations of the basis of potash are still more extraordinary than its physical ones.

I have already mentioned its alkalization and combustion in oxygen gas.—It combines with oxygen slowly and without flame at all temperatures that I have tried below that of its vaporization.—But at this temperature combustion takes place, and the light is of a brilliant whiteness and the heat intense. When heated slowly in a quantity of oxygen gas not sufficient for its complete conversion into potash, and at a temperature inadequate to its inflammation, 400° Fahrenheit for instance, its tint changes to that of a red brown, and when the heat is withdrawn, all the oxygen is found to be absorbed, and a solid is formed of a greyish colour, which partly consists of potash and partly of the basis of potash

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in a lower degree of oxygenation, and which becomes potash by being exposed to water, or by being again heated in fresh quantities of air.

The substance consisting of the basis of potash combined with an under-proportion of oxygen, may likewise be formed by fusing dry potash and its basis together under proper circumstances.—The basis rapidly loses its metallic splendour; the two substances unite into a compound, of a red brown colour when fluid, and of a dark grey hue when solid; and this compound soon absorbs its full proportion of oxygen when exposed to the air, and is wholly converted into potash.

And the same body is often formed in the analytical experiments when the action of the electricity is intense, and the potash much heated.

The basis of potash when introduced into oxymuriatic acid gas burns spontaneously with a bright red light; and a white salt proving to be muriate of potash is formed.

When a globule is heated in hydrogen at a degree below its point of vaporization, it seems to dissolve in it, for the globule diminishes in volume, and the gas explodes with alkaline fumes and bright light, when suffered to pass into the air; but by cooling, this spontaneous detonating property is destroyed, and the basis is either wholly or principally deposited.

The action of the basis of potash on water exposed to the atmosphere is connected with some beautiful phenomena. When it is thrown upon water, or when it is brought into contact with a drop of water at common temperatures, it decomposes it with great violence, an instantaneous explosion is produced with brilliant flame, and a solution of pure potash is the result.

In

In experiments of this kind, an appearance often occurs similar to that produced by the combustion of phosphuretted hydrogen; a white ring of smoke, which gradually extends as it rises into the air.

When water is made to act upon the basis of potash out of the contact of air and preserved by means of a glass tube under naphtha, the decomposition is violent; and there is much heat and noise, but no luminous appearance, and the gas evolved when examined in the mercurial or water pneumatic apparatus is found to be pure hydrogen.

When a globule of the basis of potash is placed upon ice it instantly burns with a bright flame, and a deep hole is made in the ice, which is found to contain a solution of potash.

The theory of the action of the basis of potash upon water exposed to the atmosphere, though complicated changes occur, is far from being obscure. The phenomena seem to depend on the strong attractions of the basis for oxygen and of the potash formed for water. The heat, which arises from two causes, decomposition and combination, is sufficiently intense to produce the inflammation. Water is a bad conductor of heat; the globule swims exposed to air; a part of it, there is the greatest reason to believe, is dissolved by the heated nascent hydrogen; and this substance being capable of spontaneous inflammation, explodes, and communicates the effect of combustion to any of the basis that may be yet uncombined.

When a globule confined out of the contact of air is acted upon by water, the theory of decomposition is very simple, the heat produced is rapidly carried off, so that there is no ignition; and a high temperature
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being requisite for the solution of the basis in hydrogen this combination probably does not take place, or at least it can have a momentary existence only.

The production of alkali in the decomposition of water by the basis of potash is demonstrated in a very simple and satisfactory manner by dropping a globule of it upon moistened paper tinged with turmeric. At the moment that the globule comes into contact with the water, it burns, and moves rapidly upon the paper, as if in search of moisture, leaving behind it a deep reddish brown trace, and acting upon the paper precisely as dry caustic potash.

So strong is the attraction of the basis of potash for oxygen, and so great the energy of its action upon water, that it discovers and decomposes the small quantities of water contained in alcohol and ether, even when they are carefully purified.

In ether this decomposition is connected with an instructive result. Potash is insoluble in this fluid; and when the basis of potash is thrown into it, oxygen is furnished to it, and hydrogen gas disengaged, and the alkali as it forms renders the ether white and turbid.

In both these inflammable compounds the energy of its action is proportional to the quantity of water they contain, and hydrogen and potash are the constant result.

The basis of potash when thrown into solutions of the mineral acids, inflames and burns on the surface. When it is plunged by proper means beneath the surface enveloped in potash, surrounded by naphtha, it acts upon the oxygen with the greatest intensity, and all its effects are such as may be explained from its strong affinity for this substance. In sulphuric acid a white saline substance

stance with a yellow coating, which is probably sulphate of potash surrounded by sulphur, and a gas which has the smell of sulphureous acid, and which probably is a mixture of that substance with hydrogen gas, are formed. In nitrous acid, nitrous gas is disengaged, and nitrate of potash formed.

The basis of potash readily combines with the simple inflammable solids, and with the metals; with phosphorous and sulphur, it forms compounds similar to the metallic phosphurets and sulphurets.

When it is brought in contact with a piece of phosphorus, and pressed upon, there is a considerable action: they become fluid together, burn, and produce phosphate of potash. When the experiment is made under naphtha, their combination takes place without the liberation of any elastic matter, and they form a compound which has a considerably higher point of fusion than its two constituents, and which remains a soft solid in boiling naphtha. In its appearance it perfectly agrees with a metallic phosphuret, it is of the colour of lead, and when spread out has a lustre similar to polished lead. When exposed to air at common temperatures, it slowly combines with oxygen, and becomes phosphate of potash. When heated upon a plate of platina, fumes exhale from it, and it does not burn till it attains the temperature of the rapid combustion of the basis of potash.

When the basis of potash is brought in contact with sulphur in fusion, in tubes filled with the vapour of naphtha, they combine rapidly with the evolution of heat and light, and a grey substance, in appearance like artificial sulphuret of iron, is formed, which if kept in fusion, rapidly dissolves the glass, and becomes bright

Brown. When this experiment is made in a glass tube hermetically sealed, no gas is liberated if the tube is opened under mercury; but when it is made in a tube connected with a mercurial apparatus, a small quantity of sulphuretted hydrogen is evolved, so that the phenomena are similar to those produced by the union of sulphur with the metals in which sulphuretted hydrogen is likewise disengaged, except that the ignition is stronger*. When the union is effected in the atmosphere, a great inflammation takes place, and sulphuret of potash is formed. The sulphuretted basis likewise gradually becomes oxygenated by exposure to the air, and is finally converted into sulphate.

The new substance produces some extraordinary and beautiful results with mercury. When one part of it is added to 8 or 10 parts of mercury in volume at 60° Fahrenheit, they instantly unite and form a substance exactly like mercury in colour, but which seems to have less coherence, for small portions of it appear as flattened spheres. When a globule is made to touch a globule

* The existence of hydrogen in sulphur, is rendered very probable by the ingenious researches of M. Berthollet Jun. *Annales de Chimie*, Fevrier 1807, page 143. The fact is almost demonstrated by an experiment which I saw made by W. Clayfield, Esq. at Bristol, in 1793. Copper filings and powdered sulphur, in weight in the proportion of three to one ~~reduced~~ very dry, were heated together in a retort, connected with a mercurial pneumatic apparatus. At the moment of combination a quantity of elastic fluid was liberated amounting to 9 or ten times the volume of the materials employed, and which consisted of sulphuretted hydrogen mixed with sulphurous acid. The first mentioned product, there is every reason to believe, must be referred to the sulphur, the last probably to the copper, which it is easy to conceive may have become slightly and superficially oxydated during the processes of filing and drying by heat.

of mercury about twice as large, they combine with considerable heat; the compound is fluid at the temperature of its formation; but when cool it appears as a solid metal, similar in colour to silver. If the quantity of the basis of potash is still farther increased, so as to be about one-thirtieth the weight of the mercury, the amalgam increases in hardness, and becomes brittle. The solid amalgam, in which the basis is in the smallest proportion, seems to consist of about one part in weight of basis and 70 parts of mercury, and is very soft and malleable.

When these compounds are exposed to air, they rapidly absorb oxygen; potash which deliquesces is formed; and in a few minutes the mercury is found pure and unaltered.

When a globule of the amalgam is thrown into water, it rapidly decomposes it with a hissing noise: potash is formed, pure hydrogen disengaged, and the mercury remains free.

The fluid amalgam of mercury and this substance dissolves all the metals I have exposed to it; and in this state of union mercury acts on iron and platina.

When the basis of potash is heated with gold, or silver, or copper, in a close vessel of pure glass, it rapidly acts upon them; and when the compounds are thrown into water this fluid is decomposed, potash formed, and the metals appear to be separated unaltered.

The basis of potash combines with fusible metal, and forms an alloy with it, which has a higher point of fusion than the fusible metal.

The action of the basis of potash upon the inflammable oily compound bodies, confirms the other facts of the strength of its attraction for oxygen.

On naphtha colourless and recently distilled, as I have already said, it has very little power of action; but in naphtha that has been exposed to the air it soon oxydates, and alkali is formed, which unites with the naphtha into a brown soap that collects round the globule.

On the concrete oils, (tallow, spermaceti, wax, for instance,) when heated, it acts slowly, coaly matter is deposited, a little gas * is evolved, and a soap is formed; but in these cases it is necessary that a large quantity of the oil be employed. On the fluid fixed oils it produces the same effects, but more slowly.

By heat likewise it rapidly decomposes the volatile oils; alkali is formed, a small quantity of gas is evolved, and charcoal is deposited.

When the basis of potash is thrown into camphor in fusion, the camphor soon becomes blackened, no gas is liberated in the process of decomposition, and a sapona-

* When a globule of the basis of potash is introduced into any of the fixed oils heated, the first product is pure hydrogen which arises from the decomposition of the water absorbed by the crust of potash during the exposure to the atmosphere. The gas evolved, when the globule is freed from this crust, I have found to be carbonated hydrogen requiring more than an equal bulk of oxygen gas for its complete saturation by explosion. I have made a great number of experiments, which it would be foreign to the object of this lecture to give in minute detail, on the agencies of the basis of potash on the oils. Some anomalies occurred which led to the enquiry, and the result was perfectly conclusive. Olive oil, oil of turpentine, and naphtha, when decomposed by heat, exhibited as products different proportions of charcoal, heavy inflammable gas, empyreumatic oily matter, and water, so that the existence of oxygen in them was fully proved; and accurate indications of the proportions of their elements might be gained by their decomposition by the basis of potash. Naphtha of all furnished least water and carbonic acid, and oil of turpentine the most.

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aceous compound is formed; which seems to shew that camphor contains more oxygen than the volatile oils.

The basis of potash readily reduces metallic oxyds when heated in contact with them. When a small quantity of the oxyd of iron was heated with it, to a temperature approaching its point of distillation, there was a vivid action; alkali and grey metallic particles, which dissolved with effervescence in muriatic acid, appeared. The oxyds of lead and the oxyds of tin were revived still more rapidly; and when the basis of potash was in excess, an alloy was formed with the revived metal.

In consequence of this property, the basis of potash readily decomposes flint glass and green glass, by a gentle heat; alkali is immediately formed by oxygen from the oxyds, which dissolves the glass, and a new surface is soon exposed to the agent.

At a red heat even the purest glass is altered by the basis of potash: the oxygen in the alkali of the glass seems to be divided between the two bases, the basis of potash and the alkaline basis in the glass, and oxyds, in the first degree of oxygenation, are the result. When the basis of potash is heated in tubes made of plate glass filled with the vapour of naphtha, it first acts upon the small quantity of the oxyds of cobalt and manganese in the interior surface of the glass, and a portion of alkali is formed. As the heat approaches to redness it begins to rise in vapour, and condenses in the colder parts of the tube; but at the point where the heat is strongest, a part of the vapour seems to penetrate the glass, rendering it of a deep red-brown colour; and by repeatedly distilling and heating the substance in a close tube of this kind, it finally loses its metallic form, and a thick brown crust, which slowly decomposes water, and which combines

combines with oxygen when exposed to air forming alkali, lines the interior of the tube, and in many parts is found penetrating through its substance *

. In my first experiments on the distillation of the basis of potash, I had great difficulty in accounting for these phenomena; but the knowledge of the substance it forms in its first degree of union with oxygen, afforded a satisfactory explanation.

TO BE CONCLUDED IN OUR NEXT.

List of Patents for Inventions, &c.

(Continued from Page 72.)

REBECCA CHING, of Rush Common, in the parish of St. Mary Lambeth, in the county of Surrey, widow of John Ching, late of Cheapside, in the City of London, Apothecary; for certain improvements in a medicine now called Ching's worm-destroying lozenges, for which her said late husband obtained letters patent, bearing date June 28, 1796. Dated May 7, 1808. Specification to be enrolled within one month.

JOHN HARRIOTT, of Wapping, in the county of Middlesex, Esq.; for a new fire-escape, or machinery to be used in case of fire. Dated May 10, 1808. Specification to be enrolled within one month.

WILLIAM HUNT, of the Brades, in the parish of Rowley Regis, in the county of Stafford, Iron Master; for

* This is the more obvious explanation in the present state of our knowledge; but it is more than probable that the silex of the glass likewise suffers some change, and probably decomposition. The subject I hope to be able to resume on another occasion.

a method

a method of rolling moulds or plates of trowels from pieces of either blister, sheer, or cast-steel; of a square or nearly square, or oblong form. Dated May 10, 1808. Specification to be enrolled within one month.

JOHN WATSON, late of Bury-place, Bloomsbury, in the county of Middlesex, Gent. but now a prisoner in the King's-bench Prison; for certain improvements in the art of soap-making, by which the article is in several respects ameliorated. Dated May 10, 1808. Specification to be enrolled within one month.

CHESTER GOULD, of the parish of St. Luke, Old-street, in the county of Middlesex, Gent. for certain improvements in the construction of a machine for washing or cleansing linen and various other articles. Dated May 17, 1808. Specification to be enrolled within four months.

WILLIAM CONGREVE, of Garden-court, Temple, in the county of Middlesex, Esquire; for a gun-carriage of the simplest construction, either for land or sea service, calculated to reduce very considerably the labour of working the guns, to produce a smooth and even recoil, and to prevent the violent action that takes place in common carriages when the gun is fired; at the same time the carriage is of much lighter, less expensive construction, and less liable to be struck and splintered by the enemy's shot, as presenting much less surface; when applied to the sea-service, it allows, moreover, of a very considerable reduction in the size of the port. Dated May 24, 1808. Specification to be enrolled within one month.

JOHN

JOHN STEDMAN, of Horton Kirby, in the county of Kent, Farmer; for a patten and clog of infinite utility and ease to such persons who may wear them. Dated May 24, 1808. Specification to be enrolled within one month.

WILLIAM HENRY POTTER, of No. 5, Pemberton-row, Gough-square, in the City of London, Flute-maker; for certain new improvements in German flutes and other wind musical instruments. Dated May 28, 1808. Specification to be enrolled within one month.

JOSEPH WILLMORE, of Birmingham, in the county of Warwick, Silversmith; and **JOHN TONKS**, of the same place, Plater; for a new method and processes in the manufacturing of nails. Dated May 28, 1808. Specification to be enrolled within one month.

ROBERT RANSOME, of Ipswich, in the county of Suffolk, Iron-founder; for his improvements on the wheel and swing plough. Dated May 30, 1808. Specification to be enrolled within one month.

DAVID THOMAS, of Featherstone-buildings, in the county of Middlesex, Gentleman; for a perforated vessel, percolater and frame, for making or preparing potable coffee. Dated May 30, 1808. Specification to be enrolled within one month.

THE
REPERTORY
OF
ARTS, MANUFACTURES,
AND
AGRICULTURE.

No. LXXV. SECOND SERIES. Aug. 1808.

Specification of the Patent granted to THOMAS JEFFERSON, of the Parish of Saint Saviour, Southwark, in the County of Surrey, Tanner and Leather-dresser, JOSEPH ELLIS, of the same Place and Trade, and ALEXANDER GALLOWAY, of the Parish of Saint Andrew, Holborn, in the County of Middlesex, Machinist and Engineer; for a Machine or Machines for the Purpose of finishing, glazing, and glossing, of Leather.

Dated March 7, 1808.

With a Plate.

TO all to whom these presents shall come, &c.
Now KNOW YE, that in compliance with the said proviso, I the said Alexander Galloway do hereby declare, that our said invention is particularly described and ascertained in and by the drawings thereof hereunto annexed. In witness whereof, &c.

Independent of the combination of the several parts of our machine, as represented in the perspective view of it, as given in Fig. 1, (Plate VI.) the peculiar principles
- VOL. XIII.—SECOND SERIES. U and

and properties of our invention consist, first, in placing any convenient number of glazing or graining cylindrical rollers, (or of any other convenient form for a glazer or grainer) at the extreme diameter of the wheels, or circular plates to which they are connected, with the ability of extending or contracting the distance of the extreme of each roller or glazer from the center of the wheels or plates to which they are joined, by any suitable machinery capable of promoting an accurate adjustment of the rollers or glazers over the whole extent of their length; which properties insure the same correctness of adjustment to any number of rollers or glazers, by which they are rendered capable of traversing in one and the same circle, bearing in all their parts upon any curve of the same radius which they describe. A body of rollers or glazers so placed upon a revolving spindle, axle, or shaft, act as so many burnishers, glazers or grainers, on any docile surface with which they come in contact; the degree of gloss which their friction will necessarily create will depend entirely on the velocity, pressure, and the quality of the material on which they may at any time operate.

Secondly: In the construction of the table which receives or supports the leather while the glazing rollers, burnishers or grainers act on it, at all times it must be carefully observed that the extreme of the glazing rollers, while connected to the revolving shaft, describe a circle suitable to the curve of the table, and that most accurately. When the rollers or glazers are thus adjusted to the table, it is brought up to any required degree of contact with them, having the leather to be glazed placed between them and the table; the leather being therein subject to any degree of discretionary pressure
which

which the operator may determine on. The table coming up or approaching in a discretionary manner, the revolving shaft not only enables the leather to be passed across, but down the table in any required direction; while the roller-shaft is moving at any rate of velocity; the quantity of any skin of leather to be glazed at a revolution of the roller-shaft will depend on the length of the glazing roller, the length of the skin lying on the table, and the speed with which it is moved across the table to feed the operation of the glazing rollers. The discretionary approach of the table to the roller-shaft secures also the whole surface of any skin of leather being perfectly glazed or grained (whichever may be required) notwithstanding any inequality in its substance, as the table accommodates such inequalities by advancing to, and retreating from, the revolving shaft as often as the inequalities in the substance of the leather may occur. Under all circumstances of inequality in the thickness of the leather, it is still, however, by the discretionary power of the table, at all times capable of creating an uniformity of pressure, if requisite, which contributes largely to produce an uniformity of gloss over the whole surface of any skin of leather, notwithstanding the inequalities of substance and the impediments of holes which many skins of leather possess.

Thirdly: In adopting a discretionary means which shall determine the exact degree of contact to which the table shall approach the roller-shaft, the apparatus for securing this object we denominate the *Table Guide or Stop*. By the application of this apparatus the table is prevented from running in upon the rollers when the force to bring the table up to them is applied, besides protecting the leather to be glazed from being

injured by what we term *The Blows* of the rollers, which create these indentations on the leather which can seldom or ever be eradicated completely by any subsequent degree of exertion which may be devoted to the skin.

The principles of our invention may be reduced under three general heads: First, the facility with which any number of glazing rollers are made to traverse in one precise channel; and the readiness with which an adjustment of all their parts is produced. Secondly, the table which supports the leather possessing an amplitude of discretionary power to approach to, and recede from, the roller-shaft at pleasure, with the full power of resisting the pressure of the rollers in any given ratio, between the impeller and the retarder. Thirdly, the application of an adjustable stop to the table, which determines how near the table shall approach the rollers, and which furnishes a complete protection to the rollers and the leather against any effort of advance which may be directed to the table. In whatever way these properties or principles can be achieved or obtained we regard as our invention.

Among the various ways which have presented themselves to our view during a period of considerable experience, trouble and expence, we have selected those modes of combining our principles in the formation of a machine or machines which we conceived the most advantageous, permanent and simple; and these are contained and illustrated in the respective drawings heretofore annexed, which I shall hereafter particularly explain and describe.

This machine may be worked by manual force, or by any known engine of power: a horse is equal to the working

for finishing, glazing, and glossing of Leather. 105

working of two machines, combined as the one is, as represented by the perspective drawing in Fig. 1, which, under the management of two men, will glaze, grain, and finish a number of skins of leather equal to the most steady, assiduous, and successful exertions of a dozen of men; and that too in a style of workmanship not only equal, but superior to what can be done in the ordinary modes of finishing leather.

Fig. 2, a view of the roller's shaft, with all its concomitant apparatus. B B the shaft, made very strong of wrought iron, and about five feet long, with hardened steel hollow centers, which revolve on the steel center screws C C, which pass through the uprights of the main frame A A, and which adjust the shaft to that degree of tightness where its rotation is freely allowed, yet wherein no share of lateral motion is admitted between the screws C C; and these are locked in the uprights of the main wood frame A A by the counter nuts D D. Upon the middle of the shaft B B are fixed two cast-iron plates E E, of about thirty inches in diameter, and about one inch thick, with square holes in their centers, which fit upon and come up against the flanch of the shaft: these plates are kept apart about four or five inches from each other, in a parallel direction, by means of the square cast-iron box F, which fits into the settings formed at the back of the plates. The plates thus stationed are firmly connected to the shaft B B by means of a screw, nut, or key coming up against them. To the external surfaces of the plates E E are connected four, six, or more wrought iron cocks, as at G G G G, extending about two and a half inches above the surface of each plate: in the centers of these cocks pass or traverse the drawing and pushing screws H H H H, which draw

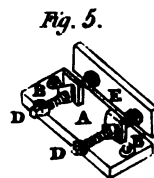
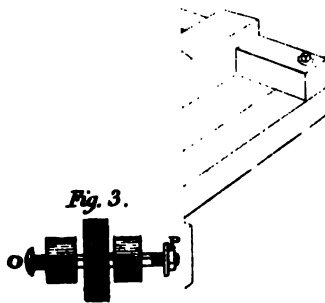
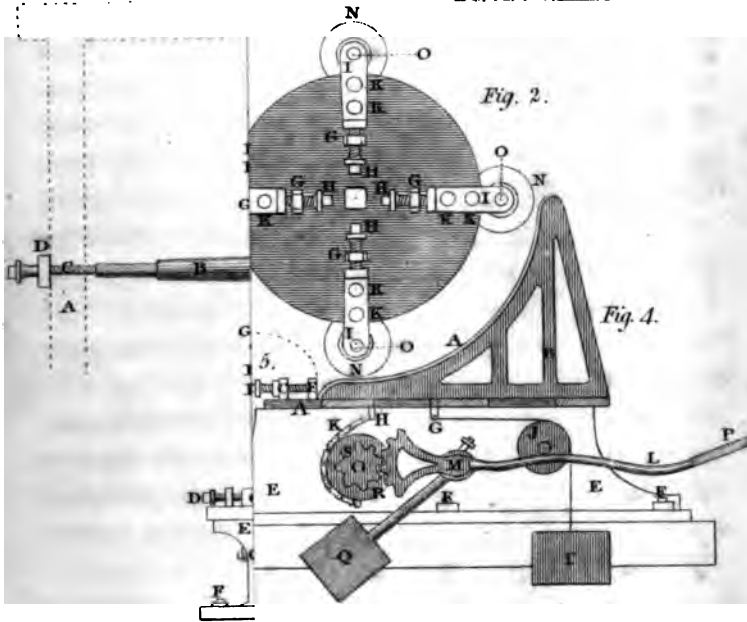
draw in and throughout the chops I I I I at discretion, the chops having been previously connected to the plates by the two binding screws K K to each chop. Upon each plate are placed a corresponding number of cocks, pushing and drawing screws, with binding screws and chops, all of which are stationed directly opposite to each other on each plate, and at their respective situations. Between each pair of opposite chops I L are placed the fluted rollers N N N N, of box wood, or other suitable material, having square holes through them into which pass the roller bolts O O O O; these bolts, although square on their shanks, are yet round about one inch from their shoulders, and they are also round about the same length at the termination of the shanks; immediately after which they are screwed to the length of about one inch, upon which the nuts P P P P fit. The roller bolts, with the fluted rollers upon them, are enabled to turn in the chops I L, which produce the advantage of presenting the whole cylindrical surface of the rollers N N N N to the action of glazing, by which means the whole of the surfaces of the rollers are brought into use as fast as any particular part becomes too much worn. These rollers are fixed firmly between each pair of chops I L, by the screw nuts P P P P being screwed upon the roller bolts O O O O up against the chops L L L L.

Fig. 3 represents the roller, its bolt, nut, collet, and its two box-wood blocks: the diameter of the roller may be of any convenient size; we, however, have found that from six to three inches answers better than either larger or smaller sizes, because a larger diameter would not only be difficult to procure in box-wood of proper quality, but a larger diameter would possess too great a leverage, which would be liable to
make

make the bolt turn in the holes of the chops when any considerable pressure was applied to it; and a smaller diameter than three inches would require not only too great a range of adjustment in the chops, but would also approach too near to the extreme of the ends of the chops, which circumstance would be liable to endanger the leather while glazing, by entangling it, or by scratching and injuring its surface. The roller N may be made of any length not exceeding six inches; but we have found, by repeated experience, that two inches long answers better than any length we have yet tried, although every length, from six to two inches, we have submitted to the test of frequent trials. The distance between the external surfaces of the plates is about six inches; full one-third of which distance is occupied by the glazing roller, and the other four inches, or two thirds of the space, are filled with the two plain box-wood blocks Q Q to the diameter of three inches, when the glazing rollers are not more than three inches and a half; this is the least possible difference in the diameter of the blocks and rollers that can be admitted. The two blocks Q Q with the fluted roller N form together a length equal to the whole distance between the chops I L. The blocks not only save a great expense in the rollers, but also possess the advantage of ranging the rollers upon the plates so as to take six inches of the width of any skin of leather in one revolution of the roller-shaft, as well as being able thereby alternately to use any two inches of the width of the table that are opposite to the distance which the roller-plates E E occupy. When the roller-plates E E have six rollers mounted on them, three of them may be used for the operation of *rolling on*, and three of them for *rolling off* with;

with ; in that case, when the operation of *rolling on* is performing, it will be necessary to draw back the *rolling off* rollers, and so *vice versa* when the operation of *rolling off* is required ; in that case it will be better to make the *rolling on* rollers travel in a different channel to the *rolling off* rollers, which is an advantage obtained by the introduction of the blocks Q Q ; besides, by shortening the rollers N N N N, a more considerable pressure of course can be applied against them than if they occupied a greater length. In making the rollers it will be necessary to observe, that they must be rounded a little on each edge from the main diameter, to prevent their cutting, creasing, or indenting the leather while the operation of glazing, graining, or finishing is performing.

Fig. 4 is a section of the curved table A, or segment of a cylinder of about 90 degrees, more or less, made either of hard wood, brass, iron, or any other suitable material, and of any convenient radius adapted to that of the rollers when they are attached to the main shaft BB, as in Fig. 2. The width of the table A may be 10 inches, more or less ; and although the table A is 90 degrees of a circle, yet we have found it of the utmost importance that about five or ten degrees, both at the top and bottom of the table, should be gradually eased or tapered off, which introduces the glazing rollers gradually and freely upon the leather when it is placed on the table, which, with the assistance of the *table guide* or *stop*, completely prevent the glazing rollers creating any injurious indentations and marks by the violence which otherwise would be occasioned by a sudden and abrupt contact with the table. By the rollers being allowed to quit the table in an easy and gradual manner, all effort there-
fore



fore, to re-action and spring is fully removed, but what is occasioned by the inequalities of the leather and the discretion of the operator; and these advantages are attained by the tapering off of the table to the extent of five or ten degrees at the bottom of it. Although hard wood will do for a table, yet, by experience, we have been fully persuaded that it is impossible for wood to retain that truth and accuracy which is necessary to the complete performance of this machine: this circumstance is alone sufficient to induce us to recommend iron or brass tables instead of wood, which not only can be made to acquire a degree of correctness, but to retain it beyond what it is possible to obtain from any kind of wood. In addition to these properties, which metal possesses over wood, the labour of glazing is not near so much with metal as with wood tables, besides the circumstance of metal tables not wearing the glazing rollers near so fast as we found the wood tables invariably to do.

For the *rolling on table* we recommend brass, and for the *rolling off table* cast iron; both of which must be a correct segment of a cylinder, with high polished surfaces extending over the whole distance of their width, two inches at least beyond the longitudinal range of the glazing rollers. The table A is attached to the strong iron stage B by means of screw bolts passing through the stage into the ribs, which are cast on the back of the table, and which are fitted into settings in the stage B. The table may be cast to the stage if found more convenient. The base of this stage is about three feet long and one foot wide and two inches thick, the sides of which are dove-tailed, and made perfectly parallel to each other from off their base. The stage B has a horizontal motion in a longitudinal direction, yet its lati-

itudinal position is regulated by the iron dove-tailed sides C C, which adjust to any degree of tightness the base of the stage B by means of cocks and screws as at D D. The sides C C are screwed by a sufficient number of screw-bolts to the main iron frame E E, upon which the base of the iron stage B rests, and moves when required in a longitudinal course. The main iron frame E E is strongly connected to the main wood frame by screw-bolts, as at F F F, or by any other secure fastenings. Upon two of the bottom rails of the iron stage B are screwed the two iron eyes G and H; to the eye G is fastened a rope or chain to which the stage weight I is suspended over the pulley J; which weight I is more than equal to the whole weight of the stage B with the table A, &c. which therefore compels the stage to retreat back as far as the advancing chain K will permit it; which retreating motion is about two inches, which is fully sufficient room to introduce the leather between the glazing rollers and the table A. The treadle L is moved upon the two center screws M M passing through the main iron frame E E. The treadle on one end of its fulcrum forms a segment of a circle of about sixty degrees, and a radius or lever of four inches; which segment is cut into cog-teeth, which operate on the cog-wheel S fixed to the chain shaft-wheel N, and causes the shaft-wheel (which moves from the center screws O O) to move one-eighth of the distance, which the long end of the treadle L describes. The length of the treadle on the pressing end of its fulcrum is about three feet, which gives the man acting on the foot-board P, (which is about sixteen inches by ten inches,) screwed to the treadle, a power of eight. Upon the treadle-axle is fixed the counter-balance weight Q, which brings up the

the treadle L always to one position when the stage B has retreated as far back as possible from the roller-shaft. Upon the axle N is fixed an iron-grooved chain wheel R, of about six inches diameter, which receives the chain K, which is connected to the eye H by a pin, the eye having been previously screwed to the bottom of the stage B, when the chain K is brought to its greatest degree of extension over the chain-wheel R, which has a groove with a flat bottom to allow the chain to move freely in it; and in the groove of the chain-wheel is keyed a standard, with a mortice across it, which receives the chain, and which connects it to the chain-wheel by a pin passing through the standard and the end joint of chain. The stage B is thus connected by the chain K to the chain-wheel R, and the cog-wheel S is fixed on the same axle N and pitched into the cogs of the treadle L: it will be obvious that the motion of the treadle L must necessarily turn the chain-wheel R, and thereby advance the stage B at one-eighth of the speed with which the treadle L at the end of the foot-board P moves. The rise of the treadle, as before stated, is produced by the counter-balance Q in the retreat of the stage B from the roller-shaft BB in Fig. 2, and the pressure of the operator on that part of the treadle at P brings up the stage to the roller-shaft with a power equal to eight times his pressure, after deducting the stage-weight I from it: on this principle the power of the operator must at all times be estimated.

Fig. 5 is a view of the *table guide* or *stop*, which consists of the plate of iron A extending across the top of the end of the main iron frame EE; by the two screws BB the plate A is fixed, and upon the plate A the two wrought-iron cocks CC, through which the two drawing

and pushing screws D D, to which are connected the bar E, which stands at right angles to the plate A. This bar is moved backwards and forwards by means of the screws D D, the bar E resting at the same time upon the plate A. Against the bar E the end of the stage of the table B in Fig. 4 strikes, and it is the discretionary use of this guide or stop, as heretofore expressed, that entirely regulates the degree of contact which is proper for the table to receive for the various sorts of leather that may be required to be glazed, grained, and finished. When the stop is thus properly adjusted to any particular kind of leather, the screws D D are locked by the counter nuts F F, which prevent any alteration of the stop or bar, which determines the degree of contact the table is to have at any time with the glazing-rollers.

Although, as we have before expressed, that one machine is adequate to all the purposes of graining, glazing, and finishing any description of leather by the changing the rollers as heretofore described to answer the two operations of *rolling on* and *rolling off* with; but as we have before expressed it as our opinion, that a table of brass is better adapted for the *rolling on* with, from the circumstance of the leather being necessary to be damper for that operation than for the other, which might be liable to damage or discolour the leather was this operation performed on an iron table, by its being liable to rust: we therefore recommend, to prevent this probable inconvenience, and to save the certain and repeated trouble of changing and adjusting the rollers, to use what we denominate a double machine; a single one of which is represented in the perspective Fig. 1.

It may be farther necessary to observe, that a platform is required for the operator to stand upon, to enable

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able him to have a proper command of the back of the table, where he stands immediately in front of the revolving roller-shaft, and which enables him to move the treadle with his foot, which brings up and keeps the table to its work ; and which also furnishes him with a complete view of the leather while it is operated upon, which he in an instant can with the utmost ease disengage, and with a corresponding facility again bring up the table to its work, while the roller-shaft is revolving at any rate of velocity. In witness whereof, &c.

Specification of the Patent granted to JAMES CAPARN, of Leicester, in the County of Leicester, Brazier ; for a Machine for discharging Smoke from smoking Chimnies. Dated October 30, 1806.

With Engravings.

TO all to whom these presents shall come, &c. NOW KNOW YE, that in compliance with the said proviso, I the said James Caparn do hereby declare that my said invention is described in the drawings delineated in the margin of these presents, and by the description thereof hereinafter particularly set forth ; that is to say : This machine, which I denominate *Caparn's Smoke Disperser*, and have invented for the prevention and cure of smoky chimnies, is to be placed on the top of the chimney over the vent or orifice, and secured thereto by brick-work, or by any other method which may be deemed expedient. The funnel of the chimney should be cleared from all contractions or other obstructions which might impede the smoke in its passage into the body of the machine. The current through the chimney gives a rotary horizontal motion to the flyers or vans at the top of the
the

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the machine, which thereby disperse the smoke and prevent the action of the atmosphere from returning it into the funnel of the chimney. The machine and its several parts are represented in the drawings delineated in the margin of these presents.

No. 1 (Figs. 1. Pl. VII.) represents the internal structure of the body of the machine. No. 2 and 2 are bars crossing each other, riveted to the sides, and supporting the upright spindle No. 4, which is incircled by the hollow barrel or cylinder No. 3, which is open at the upper end, and screwed at the bottom to the base, from which the spindle No. 4 arises, and is intended to contain oil for facilitating the motion of the vans or flyers. This barrel must be made large enough to admit the hollow cylinder No. 6, which contains a female centre to run or turn on the spindle No. 4. The figure No. 5 represents the cap or top of the machine, and consists of a set of vans or flyers, fastened at their upper extremities to the upper end of the cylinder No. 6, and riveted at the bottom to a circular rim of metal. No. 7 represents the external appearance of the whole machine when put together and complete for use; the size of which must be in proportion to the tunnel of the chimney whereon it is to be placed. The body or external case of the machine, and also the vans or flyers, and the rim to which the same are rivetted, may be made of iron, copper, or tin. The cross bars may be made of iron, and the spindle of steel, or iron faced with steel, hardened at the point working in the female centre. The female centre may also be made of steel, or iron faced with steel, hardened at the part receiving the spindle: and the two cylinders may be made of iron, cast-iron, copper, or tin.

In witness whereof, &c.

Specification

Specification of the Patent granted to JOHN DICKSON, of Edward-street, in the Parish of Christchurch, in the County of Surrey, Engineer; for an improved Method of constructing Cocks for stopping Fluids; and which Cocks, by one Motion or Operation, will permit such Fluids to pass in different Directions.

Dated March 29, 1808.

With Engravings.

TO all to whom these presents shall come, &c. NOW KNOW YE, that, in compliance with the said proviso, I the said John Dickson do hereby declare, that the nature of my said invention, and the manner in which the same is to be made and performed, are hereinafter particularly described and ascertained; that is to say: Fig. 2 (Plate VII.) in the annexed plan is an apparatus or cock constructed so as to answer all the purposes of the common place sluice and stop cocks for permitting fluids to pass and re-pass as may be requisite, and by one operation to answer the purpose of two separate cocks or valves; and which apparatus I claim as my invention.

Fig. 2, A, is a plate or piece with two apertures C and D, of any given dimensions, for permitting fluids to pass and re-pass from or to the pipe F, as may be required. These apertures are of an oblong form, which I consider the best, although they may be made of any other form. This plate or piece A, and the other parts of the apparatus, may be made of brass, iron, or any other metal or materials which may be found to agree best with the nature of the fluids acting thereon, or the purpose for which the apparatus may be wanted. The surface

surface of the plate or piece A is made sufficiently even and smooth on those parts which surround the apertures, so as to be perfectly air and steam tight when the surface of the moveable plate or piece B (which is to be equally even and smooth) comes in contact with it. The moveable plate or piece B has a curve or space made or cut in the surface of it so as to be sufficiently wide to cover both the apertures C or D and the intermediate space in the face of the plate A, so that fluids may pass from or into the apertures C and D at the same time by moving the plate or piece B in a direction parallel with its surface. By a similar motion the communication between C and D may be shut, and a communication opened at pleasure between C or D alternately and the pipe F, which pipe contains the fluid to be conveyed into, or which passes through, the apertures C and D alternately, as may be required. G is the rod by which the plate or piece B is moved. I is the stuffing-box through which the rod G passes. H is a spring pressing against the rod G, for the purpose of keeping the plate or piece B in close contact with the surface of the plate or piece A. It is also a guide for the rod.

Fig. 2 represents the said apparatus applied to a double acting steam-engine, the application of which apparatus to steam-engines I claim as my invention. Fig. 2 represents an open section of a double acting steam-engine, with the patent apparatus or cocks applied thereto.

Fig. 3 is a front view of ditto.

In witness whereof, &c.

Specification



Figs. 1.

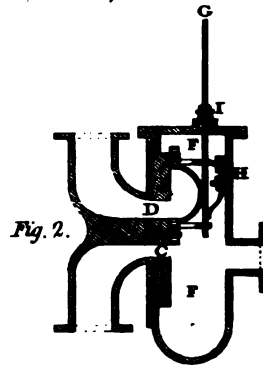
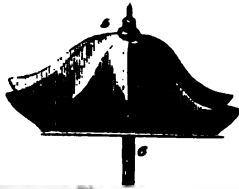
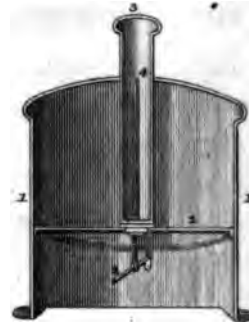


Fig. 2.

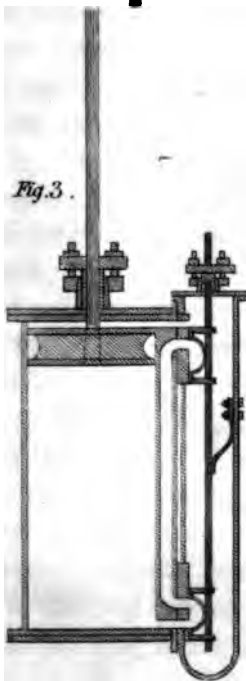


Fig. 3.

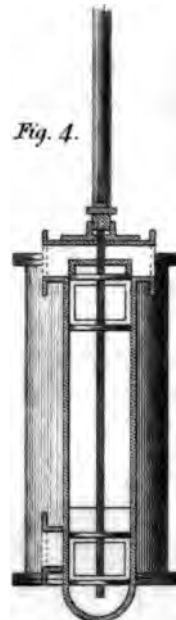


Fig. 4.

Specification of the Patent granted to CHARLES LUCAS BIRCH, of Great Queen-street, in the Parish of Saint Giles, in the County of Middlesex, Coach-maker; for an Improvement in the Construction of the Roofs and upper Quarters of Landaus, Landaulets, Barouche Landaus and Barouche Carriages, and other Carriages, the upper Parts of which are made to fall down.

Dated July 21, 1807.

TO all to whom these presents shall come, &c. NOW KNOW YE, that in compliance with the said proviso, I the said Charles Lucas Birch do hereby declare that my said invention is described in manner following; that is to say: Frame and fix in the top quarter rails to the tops of the standing pillars and slats, and fix the slats to the neck plates; rabbit the inner parts of the standing pillars, the top quarter rails and the slats, and board them with thin deals, or any other proper material. Let the crown-pieces or cornice rails be long enough to bevel or mitre into the corners of the top of the standing pillars; and let in the hinges and thimble catches on the top of the crown-pieces and top of the quarter rails. Fix on the hoop sticks and back and front rails, and board them all up except the two hoop-sticks which are nearest to the hinges, which may be placed as close as possible to admit of the head striking conveniently low. Conceal or let in one or more boxed locks to the centre hoop sticks, or at least the hoop-sticks which unite the thimble catches, and fix them so as that they may be opened by a key on the inside of the carriage. Stretch strong canvas, or other fit material, and nail it, or otherwise fasten it, both on the inside and the outside of the slats and elbows, and stuff it between with flock or tow, or other fit material. Likewise stretch and nail on or fasten canvas, or any other

proper material, to the top hoop-sticks on the roof which are nearest the hinges before you put on the leather covering.

In witness whereof, &c.

OBSERVATIONS BY THE PATENTEE.

In travelling, a carriage built upon this construction will carry one or more imperials on its roof without interfering with the regular process of opening it, and when in that situation will remain without doing the least injury to its upper parts.

The spring curtains to the landaus remain without being removed, whereas those on the old plan were obliged to be taken down, before there was a possibility of opening it.

Specification of the Patent granted to JOHN SHORTER MORRIS, of Pancras-place, in the County of Middlesex, Gentleman; for a Machine for Mangling.

Dated February 4, 1808.

With Engravings.

TO all to whom these presents shall come, &c. NOW KNOW YE, that I the said John Shorter Morris, in compliance with the said proviso, do hereby ascertain and describe the nature of my said invention, and declare that the figures and drawings annexed are explained in the manner following. The letters refer to the same figures in each drawing.

Figs. 1 and 2 (Plate VIII.) represent side views, and Fig. 3 a perspective view of the machine. *aa*, Fig. 3, a wood frame, put together with bed screws. *bb*, Fig. 2,

two

two horizontal, parallel, cylindrical rollers, whose axis bear on brass or iron let into the wood frame, one of which, *b*, is seen in Figs. 1 and 3. *c*, Figs. 1, 2, 3, a moveable roller, round which the linen or cloth to be mangled is rolled, and placed on the two rollers *b b*. *d* a roller, the axis of which works in pieces of brass or iron *e e*, Figs. 1 and 2, which slides between two pieces of brass or iron let into the inner side of the wood frame. To the bottom of *e e* is fastened the long flat piece of iron *f f*, Figs. 1, 2, 3, with hooks at their lower extremity, to which is attached the chains *g g g*, which support the scale or platform *h*, on which iron weights, pig-iron, or any other heavy substance is placed. To the top of *e e* is fastened the engine-chains *i i*, which pass through an aperture at each end of the top of the wood frame, and is fastened on the pullies at each end of the shaft *k* with a screw. The ends of the shaft *k* work in cast-iron, screwed on the top of the wood frame Fig. 3. *l* a lever, which may be fixed to either ends of the shaft *k*. *m*, Figs. 1 and 3, a handle fixed to the axis of the top roller *d*.

To use the Machine press down the lever *l*, Figs. 1, 2, 3, and fasten it with the hook *n*, Fig. 3, which raises the roller *d*, and the platform with weights on it. Then take out the roller *c*, and roll the linen and mangling cloth round it. Then place it on the rollers *b b*, unhook the lever *l*, and the weights on the platform will press the roller *d* on the roller *c*, on which the linen is rolled. Put the top roller in motion by turning the handle *m*, and it will give motion to all the other rollers, and in a short time make the linen beautifully smooth; then press down the lever, fasten it with the hook, and take the roller *c* out.

The machine as above described will mangle almost all descriptions of linen; but if any large irregular lumps are formed by the linen rolled round the roller, I put a band round all the rollers: hence, when the top roller is put in motion, it will communicate motion to the two bottom rollers, and oblige the roller *c* to act with them; and shall sometimes fix a fly-wheel to the axis of the top roller, or fix a wheel with teeth on the axis of each of the bottom rollers, and one between them to connect them. Then the fly-wheel may be put on the axis of either of those wheels; the fly-wheel to be on the opposite side of the machine to the handle *m*. As a substitute for the platform and iron weights, a box may be suspended, in which stones, sand, gravel, or any substance may be placed to act as a weight.

The utility of this machine is not confined to mangling only, but may be used with success as a copper-plate printing-press, a letter copying machine, or a cylindrical press, either as represented in Figs. 1, 2, 3. or with two rollers only; one with its axis bearing on brass or iron let into the wood frame, and the other as *d* pressing on it.

In witness whereof, &c.

OBSERVATIONS BY THE PATENTEE.

From experiments which have been tried with this machine, it appears to act best with a wheel on the axis of each of the bottom cylinders, and a pinion between them, with the fly-wheel on the pinion, and motion given from the fly-wheel; thus it will pass over all inequalities with great ease. The top cylinders and weights rising and falling as they approach, from the

two bottom cylinders being put a little asunder, the one on which the linen is rolled acts as a wedge, greatly increasing the power of the weights, giving the linen three equal pressures. Upon the whole, this machine mangles with greater ease, performs its work better, and with more expedition than any before invented, and is very compact in its construction.

On the Cultivation of the Poppy.

By T. COGAN, M.D.

(Concluded from Page 119.)

Harvest.

IN the beginning, middle, or end of August, according as the time of sowing has been earlier or later, and the season propitious, the seeds are ripe for gathering the poppy heads. Several methods have been recommended to harvest the crop. At first, the heads or balls were broken off from their stems, gathered together in large quantities, and deposited in a barn, or any other convenient place, in large heaps, in order to dry them. This method was not only tedious but injurious; some of the balls becoming musty communicated a disagreeable taste to the seeds, and consequently to the oil. Mr. Poske, of Zell, in the electorate of Hanover, prefers the following method. He draws the entire plants out of the ground; binds a sufficient number of them at each extremity, and places them against each other in the manner of *wheat-sheaves*; and lets the whole remain in the field for eight or ten days, until they are perfectly dry. It was customary to cut open the capsulum with a knife: he prefers hacking it in two or three places

places with a *bill-hook*, and asserts that one person may in this manner do more work than ten times the number of hands in the former manner; and that the seeds are more easily evacuated from their cells. But the most convenient and expeditious method is to cut off the poppy heads as they stand in the field; the reapers having an apron before them, tied up at the corners. In this they collect as large a number as is convenient, and empty them into bushel baskets placed upon a cloth, by which a considerable quantity of seed is saved. The heads are afterwards put into corn sacks, in a competent number to be trodden by men or children in *sabots*, or to be bruised by a mallet or flail: by these means the heads are confined from flying from the stroke, and the seeds preserved from being scattered, and afterwards passed through a sieve of a proper size.

In extracting the oil, it is of the utmost consequence that mill, press, and bags be perfectly clean and pure. New bags are necessary, as those used for linseed, rape or any other seed, will communicate an unpleasant taste to the oil. It is adviseable to extract the oil as soon after the harvest as possible, as the seeds will yield a larger quantity than if deferred till the spring.

The first oil is destined for the use of families. This is *cold-drawn*, as any degree of warmth injures the flavour. After as much is extracted in this manner as possible, a considerable quantity of an inferior quality is obtained by heating the cakes, and pressing them a second time.

The oil expressed must remain for the space of five or six weeks before it is used, that it may deposit in a sediment a kind of milky substance that is mixed with it. It must then be poured into another vessel; and this should

should not be perfectly closed at first, but the opening be covered with a linen cloth, or a pricked bladder, that certain exhalations may pass. Nor should the oil be immediately used after the process is finished, as it continues to improve for a considerable length of time.

That which is first expressed is of a pale colour; is peculiarly bland and soft, has a flavour approaching to that of the almond oil. It is used for sallads and other domestic purposes, either alone or mixed with olive oil. Should the latter be stale or rancid, it will be considerably improved by a mixture of recent poppy oil. It is not asserted that this oil may be placed in competition with Provence or Italian oils of prime quality; but that it is superior to the olive oils sold in shops, being often used to improve their quality. May I not add, that the inhabitants of this country are somewhat prepared for the culinary use of this oil, by being already accustomed to its taste, though without their knowledge. For since it has long been imported into Holland, and used without suspicion, we cannot suppose that the merchants of this commercial nation are totally strangers to the commodity*.

* We are told by Mr. C. A. Fisher, in his "Letters written during a Journey to Montpellier, in the year 1804," "that the oil of Provence, which, on account of its purity, mildness, and fine flavour, is famous all over Europe, is exported to Italy in large quantities, and was formerly exported to many distant countries. But since the hard winters of 1789 and the following years, so many olive trees have been frozen, and during the Revolution so few planted, that Aix (which was the principal seat of its traffic) has now entirely lost its first and most lucrative branch of Commerce."

Two inferences may be drawn from the above information. Our best oils, though imported from Italy, are probably of the growth of Provence: and it is still more probable that the inferior sorts could not be afforded, even at the present price, without a large mixture of the *poppy oil*.

The

The second-drawn oils are of a deeper colour, and are applicable to all the purposes of the more common oils. This may even be used as lamp oil; and it is alleged, that it does not give off so large a quantity of smoke, and emits a brighter flame.

The oil-cakes are peculiarly serviceable for feeding and fattening of cattle; being deemed equal to linseed-cakes. All cattle are very fond of it, and eat it with eagerness. This is the constant use of it in Brabant. The stems are sometimes used for fodder, containing a considerable quantity of nutritive oils; or mixed with stable dung and other manures, they enrich their quality.

Expenses, produce, and profits. Concerning these articles it will be necessary to be particular, though it is somewhat difficult from a difference in the current coins, measures, &c. I shall state the result of experiments made on three hundred roeden *, about one acre, of a sandy soil, and three hundred roeden of a heavy peat, made by a claimant named S. N. Van Eys. The peat land being low and humid, he was obliged to make deep trenches between the beds. The harvest on this soil was later, the poppy heads were not so dry when gathered, and they shrunk considerably in drying. There was so small a difference in the quantity of seed from these different soils, that no important preference could be given. The sand ground yielded in this instance rather less than the peat land. As the quality of the seeds appeared perfectly similar, he mixed the whole produce together when he sent them to the oil mills.

* The English statute acre is 160 square perches; and the Dutch morge, consisting of 600 roeden, is equal to 300 square perches; so that the difference between a Dutch morge and two acres is as 300 to 320, the former being only 20 perches less than two acres.

The produce of the sand ground rather exceeded 13 sacks, that of the *veen* or peat land was about 12 sacks: together they made 25 sacks 1 bushel of seed. These yielded of oil in the following proportions:—

	Mingles*.	Cakes.
23 sacks which were pressed <i>cold</i> gave	271	834
2 sacks <i>warmed</i>	29	56
834 cakes <i>warmed</i> and pressed gave	73	
Total oil	373	890
Cakes diminished in a second pressure to		
726	minus,	108
Total of cakes		782

Mr. Van Eys remarks that poppy-oil of a very inferior quality is sold retail at one guilder, or 1s. 10d. per mingle or quart, and that mixed with olive oil at a much higher price. However, he estimates the cold-drawn at 16d. only, and the second sort at 14d. per mingle. The cakes are valued at ten guilders, or 19s. per 100. His receipts stand thus:

271 Mingles (cold-drawn)		
at 16d.	F. 216	16
102 Ditto (warm) at 14d.	71	8
782 Cakes at 10 f. per 100	78	4
Total	F. 366	8 — £.33 0 8

* A mingle is about two pints.

Statement of Expenses.

To digging, &c. 600 roeden,					
at 1½d. per r.	F. 52	10			
Seed, sowing, weeding, &c.....	42	19			
Harvesting, beating out seed, &c.	48	3			
Pressing out the oil, bags, &c.	63	8			
Total	F. 207	0	—£.18	14	8
Receipts	F. 366	8	0—£.33	0	8
Expenses	207	0	0—	18	14 0
Total of Profit.....	F. 159	8	0—£.14	6	8

This degree of profit upon nearly two acres does not at first appear to be encouraging; particularly if we take into consideration rent of land, taxes, &c. which are not mentioned in the statement. Mr. Van Eys has remarked, that the expenses attendant upon pressing out the oil in this first essay were considerably greater than would be experienced in the usual course of business. We may also notice that the preparation of the ground by manual labour created a difference in expense that would prove an equivalent at least to the value of land and contingent charges. But what is of much greater moment is the very low price of the oil, as stated in the above account. That of an inferior quality being valued at somewhat less than 5s. *per* gallon; and the superior at less than 5s. 6d.; whereas common lamp oil is with us sold for 6s. *per* gallon, and salad oil

of no extraordinary quality at 2s. 6d. or 3s. *per* pint, or 1l. or 1l. 4s. *per* gallon.

It clearly appears from these facts, that 1s. 6d. *per* pint, or 12s. *per* gallon for the prime article *wholesale*, and at least 4s. *per* gallon for the inferior sort, would be an advantageous price for the purchaser; who would be able to retail it considerably under the current prices of these articles.

According to this estimate, the receipts upon 271 mingelen or quarts of the *cold-draw* would amount to about 40l. ; upon 102 quarts of the inferior to 5l. ; and upon 782 cakes at 1l. *per* 100 to 7l. 10s. ; total 52l. 10s. for one *morge*, which would be after the ratio of 26l. 5s. *per* acre. The expenses not exceeding 10l. *per* acre, would yield a clear profit of 16l.

Should the oil of superior quality answer the description given of it, and be more palatable than the olive oil in common use, 12s. *per* gallon would perhaps be too low an estimate for our national character. For observation authorizes me to assert it as a serious fact, that nothing has a greater tendency with us to depreciate articles of nutrition, especially if they approach to luxuries, than to render them too cheap. And although we complain universally that such articles are extravagantly dear, we almost as universally suspect or despise whatever may be purchased at a very reasonable price. But as retailers are both able and willing to obviate this objection, the above statement for the *vender in wholesale* may be permitted to remain.

But there is another important point of view in which this subject may be considered. Successful attempts have lately been made to procure *opium* from the poppy, in no respect inferior to that imported from the

East *; and it is asserted, that although it may be afforded at a very inferior price, the product would afford ample profits to the cultivator. As the opium issues from the *rind*, and the seeds have been proved not to partake of its narcotic properties, an important inquiry presents itself, *Whether the poppy may not be cultivated with a view to both articles?* This can only be determined by solving another question, *Will the incisions made in the green and unripe capsulum and the exudation of its juices, prove injurious to the seeds in this advanced state of its growth?* The argument from analogy, which is the only mode until we can obtain facts, appears to favour the negative of the question; not only as there is no immediate correspondence in the qualities of these two parts of the same vegetable, but as many experiments have proved that by checking the growth, or weakening the vegetative powers of one part of a plant, they are increased and improved in another.

Desirous of obtaining some information concerning this interesting subject, I sowed in the year 1804 about half a lug of garden-ground with the white poppy seed; and when the heads were advanced to a sufficient state of maturity, I scarified the external surface of one portion of them with a pen-knife, suffering the others to remain entire; and though the exudations were very considerable, there was no perceptible difference in the colour, taste, or size of the seeds; excepting where the incisions passed through the whole integument, which frequently happened from the imperfection of the instrument, and my inexpertness. The seeds which lay

* See Transactions of the Society, instituted at London, for the Encouragement of Arts, &c. on the mode and advantages attending the cultivation of Opium; Vols. XIV. XV. XVI. XVIII.; and former volumes of this work.

nearest to the openings were discoloured by the admission of external air; but the taste of the seed was not injured.

This little experiment served to convince me that the seeds of the poppy are peculiarly grateful to birds, rats, and mice. The first dexterously made large holes in the lower surface of the ball, through which the seed fell to the ground; and they thus materially injured a considerable portion of my crop while it was standing; nor were the latter less destructive, when the poppy heads were spread upon the floor of the summer-house in order to dry them. I was, however, indemnified for this loss, by observing that not a single instance of mortality presented itself to evince the noxious quality of the seed.

If future experiments should prove that both objects may be pursued by the same culture, scarcely any plan can be devised which would prove equally profitable to the cultivator, and more beneficial to the community.

I am not so sanguine as to expect that any person upon reading the above account will immediately resolve to cultivate the poppy to a great extent, as an article of profit. There is often a long repose between the acquisition of knowledge and the application of it to practical purposes; and in this case I allow that many difficulties are to be surmounted before the open and avowed consumption of this oil would be sufficiently extensive to make the production of it an object of sufficient magnitude. But the increasing demands for oils of all sorts in our extensive manufactories, and by the daily improvements in our provincial towns, the immense sums expended in the importation of foreign oils, and most probably of this very oil under a false name; and the

the daily increase of their price, render a power in reserve most desirable. The time may arrive when the scarcity of oils for domestic use may increase to an alarming degree; in this case the general reluctance to the use of those which are now deemed of an inferior quality, may in great measure subside, and we may perhaps rejoice at being supplied at a cheaper rate with that very oil which passes smoothly among us under the fictitious character of *genuine oil of olives*. I shall at least enjoy the satisfaction of putting it in the power of the public to assist themselves at some future period; and take encouragement respecting the success of my endeavours from the nature of this very plant, which is frequently known to lie for years in the soil in a state perfectly inert, until some favourable circumstances may have promoted a vigorous vegetation, to the surprise and alarm of the farmer, who has uniformly mistaken it for a *weed*.

N. B. It may be objected, that in the above estimate of the profits, mention is not made of the duties which may hereafter be imposed by government, and become considerable deductions. But this objection has no reference to our first essays. The duties will not become an object until the product of poppy oils shall sensibly diminish the importation of foreign oils; and in that case the wisdom of government will doubtless prevent their rising so high as to operate as a discouragement to a culture which would turn the balance of the oil trade in our favour; and should we be able to extend this culture so far as to export the article, a very moderate duty upon both home consumption and exportation may prove more than equivalent to the duties at present collected.

Since

Since writing the above, I am informed by a person who deals largely in foreign oils, that letters from Leghorn announce an alarming deficiency in the last year's product; that the quantity is very small, and of a very inferior quality. This information should operate as an additional motive to the attempt recommended. The injury induced upon olive trees by inclement weather is frequently to such an extent that it can only be repaired by the slow growth of new plantations. This circumstance gives an astonishing advantage to a substitute, of which, by its being an annual product, the deficiency of the most unfavourable year cannot be equally extensive, and would probably be supplied by the increased abundance of the year ensuing.

The Bakerian Lecture, on some new Phenomena of chemical Changes produced by Electricity, particularly the Decomposition of the fixed Alkalies, and the Exhibition of the new Substances which constitute their Bases; and on the general Nature of alkaline Bodies.

By HUMPHRY DAVY, Esq. Sec. R. S. M. R. I. A.

(Concluded from Page 142.)

V. *On the Properties and Nature of the Basis of Soda.*

THE basis of soda, as I have already mentioned, is a solid at common temperatures. It is white, opaque, and, when examined under a film of naphtha, has the lustre and general appearance of silver. It is exceedingly malleable, and is much softer than any of the common metallic substances. When pressed upon by a platina blade, with a small force, it spreads into thin leaves, and a globule of the one-tenth or one-twelfth of an inch in diameter

diameter is easily spread over a surface of a quarter of an inch *, and this property does not diminish when it is cooled to 32° Fahrenheit.

It conducts electricity and heat in a similar manner to the basis of potash ; and small globules of it inflame by the voltaic electrical spark, and burn with bright explosions.

Its specific gravity is less than that of water. It swims in oil of sassafras of 1.096, water being 1, and sinks in naphtha of specific gravity .861. This circumstance enabled me to ascertain the point with precision. I mixed together oil of sassafras and naphtha, which combine very perfectly, observing the proportions till I had composed a fluid, in which it remained at rest above or below ; and this fluid consisted of nearly twelve parts naphtha and five of oil of sassafras, which gives a specific gravity to that of water, nearly as nine to ten, or, more accurately, as 9348 to 1.

The basis of soda has a much higher point of fusion than the basis of potash ; its parts begin to lose their cohesion at about 120° Fahrenheit, and it is a perfect fluid at about 180°, so that it readily fuses under boiling naphtha.

I have not yet been able to ascertain at what degree of heat it is volatile ; but it remains fixed in a state of ignition at the point of fusion of plate glass.

The chemical phenomena produced by the basis of soda are analogous to those produced by the basis of potash ; but with such characteristic differences as might be well expected.

* Globules may be easily made to adhere and form one mass by strong pressure : so that the property of welding, which belongs to iron and platina at a white heat only, is possessed by this substance at common temperatures.

When

When the basis of soda is exposed to the atmosphere, it immediately tarnishes, and by degrees becomes covered with a white crust, which deliquesces much more slowly than the substance which forms on the basis of potash. It proves, on minute examination, to be pure soda.

The basis of soda combines with oxygen slowly, and without luminous appearance at all common temperatures; and when heated this combination becomes more rapid; but no light is emitted till it has acquired a temperature nearly that of ignition.

The flame that it produces in oxygen gas is white, and it sends forth bright sparks, occasioning a very beautiful effect; in common air, it burns with light of the colour of that produced during the combustion of charcoal, but much brighter.

The basis of soda when heated in hydrogen seemed to have no action upon it. When introduced into oxymuriatic acid gas, it burnt vividly with numerous scintillations of a bright red colour. Saline matter was formed in this combustion, which, as might have been expected, proved to be muriate of soda.

Its operation upon water offers most satisfactory evidence of its nature. When thrown upon this fluid, it produces a violent effervescence, with a loud hissing noise; it combines with the oxygen of the water to form soda, which is dissolved, and its hydrogen is disengaged. In this operation there is no luminous appearance; and it seems probable that even in the nascent state hydrogen is incapable of combining with it *.

* The more volatile metals only seem capable of uniting with hydrogen; a circumstance presenting an analogy.

When the basis of soda is thrown into hot water, the decomposition is more violent, and in this case a few scintillations are generally observed at the surface of the fluid; but this is owing to small particles of the basis, which are thrown out of the water sufficiently heated to burn in passing through the atmosphere. When, however, a globule is brought in contact with a small particle of water, or with moistened paper, the heat produced (there being no medium to carry it off rapidly) is usually sufficient for the accension of the basis.

The basis of soda acts upon alcohol and ether, precisely in a similar manner with the basis of potash. The water that they contain is decomposed; soda is rapidly formed, and hydrogen disengaged.

The basis of soda, when thrown upon the strong acids, acts upon them with great energy. When nitrous acid is employed, a vivid inflammation is produced; with muriatic and sulphuric acid there is much heat generated, but no light.

When plunged, by proper means, beneath the surface of the acids, it is rapidly oxygenated; soda is produced, and the other educts are similar to those generated by the action of the basis of potash.

With respect to the fixed and volatile oils and naphtha in their different states, there is a perfect coincidence between the effects of the two new substances, except in the difference of the appearances of the saponaceous compounds formed; those produced by the oxydation and combination of the basis of soda being of a darker colour, and apparently less soluble.

The basis of soda, in its degrees of oxydation, has precisely similar habits with the basis of potash.

When

When it is fused with dry soda, in certain quantities, there is a division of oxygen between the alkali and the base; and a deep brown fluid is produced, which becomes a dark grey solid on cooling, and which attracts oxygen from the air, or which decomposes water, and becomes soda.

The same body is often formed in the analytical processes of decomposition; and it is generated when the basis of soda is fused in tubes of the purest plate-glass.

There is scarcely any difference in the visible phenomena of the agencies of the basis of soda, and that of potash on sulphur, phosphorus, and the metals.

It combines with sulphur in close vessels filled with the vapour of naphtha with great vividness, with light, heat, and often with explosion from the vaporization of a portion of sulphur, and the disengagement of sulphuretted hydrogen gas. The sulphuretted basis of soda is of a deep grey colour.

The phosphuret has the appearance of lead, and forms phosphate of soda by exposure to air, or by combustion.

The basis of soda in the quantity of one-fortieth, renders mercury a fixed solid of the colour of silver, and the combination is attended with a considerable degree of heat.

It makes an alloy with tin, without changing its colour, and it acts upon lead and gold when heated. I have not examined its habitudes with any other metals, but in its state of alloy it is soon converted into soda by exposure to air, or by the action of water, which it decomposes with the evolution of hydrogen.

The amalgam of mercury and the basis of soda, seems to form triple compounds with other metals. I have

tried iron and platina, which I am inclined to believe remain in combination with the mercury, when it is deprived of the new substance by exposure to air.

The amalgam of the basis of soda and mercury likewise combines with sulphur, and forms a triple compound of a dark grey colour.

VI. *On the Proportions of the peculiar Bases and Oxygen in Potash and Soda.*

The facility of combustion of the bases of the alkalies, and the readiness with which they decomposed water, offered means fully adequate for determining the proportions of their ponderable constituent parts.

I shall mention the general methods of the experiments, and the results obtained by the different series, which approach as near to each other as can be expected in operations performed on such small quantities of materials.

For the process in oxygen gas, I employed glass tubes containing small trays made of thin leaves of silver or other noble metals, on which the substance to be burnt, after being accurately weighed or compared with a globule of mercury, equal in size *, was placed: the tube was small at one end, curved, and brought to a fine point, but suffered to remain open; and the other end was fitted to a tube communicating with a gazometer, from which the oxygen gas was introduced, for neither water nor mercury could be used for filling the apparatus. The oxygen gas was carried through the

* When the globules were very small, the comparison with mercury, which may be quickly made by means of a micrometer, was generally employed as the means of ascertaining the weight: for in this case the globule could be immediately introduced into the tube, and the weight of mercury ascertained at leisure,

tube

tube till it was found that the whole of the common air was expelled. The degree of its purity was ascertained by suffering a small quantity to pass into the mercurial apparatus. The lower orifice was then hermetically sealed by a spirit-lamp, and the upper part drawn out and finally closed, when the aperture was so small, as to render the temperature employed incapable of materially influencing the volume of the gas; and when the whole arrangement was made, the combination was effected by applying heat to the glass in contact with the metallic tray.

In performing these experiments many difficulties occurred. When the flame of the lamp was immediately brought to play upon the glass, the combustion was very vivid, so as sometimes to break the tube; and the alkali generated partly rose in white fumes, which were deposited upon the glass.

When the temperature was slowly raised, the bases of the alkalies acted upon the metallic tray, and formed alloys, and in this state it was very difficult to combine them with their full proportion of oxygen; and glass alone could not be employed on account of its decomposition by the alkaline bases; and porcelain is so bad a conductor of heat, that it was not possible to raise it to the point required for the process, without softening the glass.

In all cases the globules of the alkaline bases were carefully freed from naphtha before they were introduced; of course a slight crust of alkali was formed before the combustion, but this could not materially affect the result; and when such a precaution was not used, an explosion generally took place from the vaporization
and

and decomposition of the film of naphtha surrounding the globe.

After the combustion, the absorption of gas was ascertained, by opening the lower point of the tube under water or mercury. In some cases the purity of the residual air was ascertained, in others the alkali formed in the tray was weighed.

From several experiments on the synthesis of potash by combustion, I shall select two, which were made with every possible attention to accuracy, and under favourable circumstances, for a mean result.

In the first experiment 0.12 grains of the basis were employed. The combustion was made upon platina, and was rapid and complete; and the basis appeared to be perfectly saturated, as no disengagement of hydrogen took place when the platina tray was thrown into water. The oxygen gas absorbed equalled in volume 190 grains of quicksilver; barometer being at 29.6 inches, thermometer 62° Fahrenheit; and this reduced to a temperature of 60° Fahrenheit, and under a pressure equal to that indicated by 30 inches *, would become 186.67 measures, the weight of which would be about .0184 grains Troy †; but .0184 : .1384 :: 13.29 : 100; and ac-

* In the correction for temperature, the estimations of Dalton and Gay-Lussac are taken, which make gases expand about $\frac{1}{273}$ of the primitive volume for every degree of Fahrenheit.

† From experiments that I made in 1799, on the specific gravity of oxygen gas, it would appear that its weight is to that of water as 1 to 748, and to that of quicksilver as 1 to 10142. *Researches Chem. and Phil.* p. 9; and with this estimation, that deducible from the late accurate researches of Messrs. Allen and Pepys on the combustion of the diamond almost precisely agrees. *Phil. Trans.* 1807, page 215.

According to this estimation 100 parts of potash will consist of 86.7 basis, and 13.3 oxygen nearly.

In the second experiment .07 grains of the basis absorbed at temperature 63° of Fahrenheit, and under pressure equal to 30.1 barometer inches, a quantity of oxygen equal in volume to 121 grains of mercury, and the proper corrections being made as in the former case, this gas would weigh .01189 grains.

But as $.07 + .01189 = .08189 : .07 :: 100 : 85.48$ nearly and 100 parts of potash will consist of 85.5 of basis and 14.5 of oxygen nearly. And the mean of the two experiments will be 86.1 of basis to 13.9 of oxygen for 100 parts.

In the most accurate experiment that I made on the combustion of the basis of soda, .08 parts of the basis absorbed a quantity of oxygen equal in volume to 206 grains of mercury; the thermometer being at 56° Fahrenheit; and the barometer at 29.4; and this quantity, the correction being made as before for the mean temperature and pressure, equals about .02 grains of oxygen.

And as $.08 + .02 = .10 : .08 :: 100 : 80$, and 100 parts of soda according to this estimation will consist of 80 basis to 20 of oxygen.

In all cases of slow combustion, in which the alkalies were not carried out of the tray, I found a considerable increase of weight, but as it was impossible to weigh them except in the atmosphere, the moisture attracted rendered the results doubtful; and the proportions from the weight of the oxygen absorbed are more to be depended on. In the experiments in which the processes of weighing were most speedily performed, and in which no alkali adhered to the tube, the basis of potash gained
nearly

nearly two parts for ten, and that of soda between three and four parts.

The results of the decomposition of water by the bases of the alkalis were much more readily and perfectly obtained than those of their combustion.

To check the rapidity of the process, and, in the case of potash, to prevent any of the basis from being dissolved, I employed the amalgams with mercury. I used a known weight of the bases, and made the amalgams under naphtha, using about two parts of mercury in volume to one of basis.

In the first instances I placed the amalgams under tubes filled with naphtha, and inverted in glasses of naphtha, and slowly admitted water to the amalgam at the bottom of the glass; but this precaution I soon found unnecessary, for the action of the water was not so intense but that the hydrogen gas could be wholly collected.

I shall give an account of the most accurate experiments made on the decomposition of water by the bases of potash and soda.

In an experiment on the basis of potash conducted with every attention that I could pay to the minutiae of the operations, hydrogen gas, equal in volume to 298 grains of mercury, were disengaged by the action of .08 grains of the basis of potash which had been amalgamated with about three grains of mercury. The thermometer at the end of the process indicated a temperature of 56° Fahrenheit, and the barometer an atmospheric pressure equal to 29.6 inches.

Now this quantity of hydrogen * would require for its combustion a volume of oxygen gas about equal to that

* *Researches Chem. and Phil.* page 287.

occupied by 154.9 grains of mercury, which gives the weight of oxygen required to saturate the .08 grains of the basis of potash at the mean temperature and pressure nearly .0151 grains. And $.08 + .0151 = .0951 : .08 :: 100 : 84.1$ nearly.

And according to these indications 100 parts of potash consist of about 84 basis and 16 oxygen.

In an experiment on the decomposition of water by the basis of soda, the mercury in the barometer standing at 30.4 inches, and in the thermometer at 52° Fahrenheit, the volume of hydrogen gas evolved by the action of .054 grains of basis equaled that of 326 grains of quicksilver. Now this at the mean temperature and pressure would require for its conversion into water, .0172 of oxygen, and $.054 + .0172 = .0712 : .054 :: 100 : 76$ nearly; and according to these indications 100 parts of soda consist of nearly 76 basis and 24 oxygen.

In another experiment, made with very great care, .052 of the basis of soda were used; the mercury in the barometer was at 29.9 inches, and that in the thermometer at 58° Fahrenheit. The volume of hydrogen evolved was equal to that of 302 grains of mercury; which would demand for its saturation by combustion, at the mean temperature and pressure .01549 grains of oxygen; and 100 parts of soda, according to this proportion, would consist nearly of 77 basis, and 23 oxygen.

The experiments which have been just detailed, are those in which the largest quantities of materials were employed; I have compared their results, however, with the results of several others, in which the decomposition of water was performed with great care, but in which the proportion of the bases was still more minute: the

largest quantity of oxygen indicated by these experiments was, for potash 17, and for soda 26 parts in 100, and the smallest 13 and 19; and, comparing all the estimations, it will probably be a good approximation to the truth, to consider potash as composed of about 6 parts basis and 1 of oxygen: and soda, as consisting of 7 basis and 2 oxygen.

VII. *Some general Observations on the Relations of the Bases of Potash and Soda to other Bodies.*

Should the bases of potash and soda be called metals? The greater number of philosophical persons to whom this question has been put, have answered in the affirmative. They agree with metals in opacity, lustre, malleability, conducting powers as to heat and electricity, and in their qualities of chemical combination.

Their low specific gravity does not appear a sufficient reason for making them a new class; for amongst the metals themselves there are remarkable differences in this respect, platina being nearly four times as heavy as tellurium*; and in the philosophical division of the classes of bodies, the analogy between the greater number of properties must always be the foundation of arrangement.

On this idea, in naming the bases of potash and soda, it will be proper to adopt the termination which, by common consent, has been applied to other newly-dis-

* Tellurium is not much more than six times as heavy as the basis of soda. There is great reason to believe that bodies of a similar chemical nature to the bases of potash and soda will be found of intermediate specific gravities between them and the lightest of the common metals. Of this subject I shall treat again in the text in course of the following pages.

covered metals, and which, though originally Latin, is now naturalized in our language.

Potassium and Sodium are the names by which I have ventured to call the two new substances : and whatever changes of theory, with regard to the composition of bodies, may hereafter take place, these terms can scarcely express an error ; for they may be considered as implying simply the metals produced from potash and soda. I have consulted with many of the most eminent scientific persons in this country, upon the methods of derivation, and the one I have adopted has been the one most generally approved. It is perhaps more significant than elegant. But it was not possible to found names upon specific properties not common to both ; and though a name for the basis of soda might have been borrowed from the Greek, yet an analogous one could not have been applied to that of potash, for the Ancients do not seem to have distinguished between the two alkalies.

The more caution is necessary in avoiding any theoretical expression in the terms, because the new electro-chemical phenomena that are daily becoming disclosed, seems distinctly to shew that the mature time for a complete generalization of chemical facts is yet far distant ; and though, in the explanations of the various results of experiments that have been detailed, the antiphlogistic solution of the phenomena has been uniformly adopted, yet the motive for employing it has been rather a sense of its beauty and precision, than a conviction of its permanency and truth.

The discovery of the agencies of the gases destroyed the hypothesis of Stahl. The knowledge of the powers and effects of the ethereal substances may at a future

time possibly act a similar part with regard to the more refined and ingenious hypothesis of Lavoisier; but, in the present state of our knowledge, it appears the best approximation that has been made to a perfect logic of chemistry.

Whatever future changes may take place in theory, there seems however every reason to believe that the metallic bases of the alkalis, and the common metals, will stand in the same arrangement of substances; and as yet we have no good reasons for assuming the compound nature of this class of bodies*.

The experiments in which it is said that alkalis, metallic oxyds and earths, may be formed from air and water alone, in processes of vegetation, have been always made in an inconclusive manner†; for distilled

* A phlogistic chemical theory might certainly be defended, on the idea that the metals are compounds of certain unknown bases with the same matter as that existing in hydrogen; and the metallic oxyds, alkalis and acids, compounds of the same bases with water; but in this theory more unknown principles would be assumed than in the generally received theory. It would be less elegant and less distinct. In my first experiments on the distillation of the basis of potash, finding hydrogen generally produced, I was led to compare the phlogistic hypothesis with the new facts; and I found it fully adequate to the explanation. More delicate researches, however, afterwards proved, that in the cases when inflammable gases appeared, water, or some body in which hydrogen is admitted to exist, was present.

† The explanation of Van Helmont of his fact of the production of earth in the growth of the willow, was completely overturned by the researches of Woodward. Phil. Trans. Vol. XXI. page 193.

The conclusions which M. Braconnot has very lately drawn from his ingenious experiments, *Annales de Chimie*, Fevrier 1807, p. 187, are rendered of little avail, in consequence of the circumstances stated in the text. In the only case of vegetation in which the free atmosphere was excluded, the seeds grew in white sand, which is
stated

water, as I have endeavoured to shew*, may contain both saline and metallic impregnations; and the free atmosphere almost constantly holds in mechanical suspension solid substances of various kinds.

In the common processes of nature, all the products of living beings may be easily conceived to be elicited from known combinations of matter. The compounds of iron, of the alkalies and earths, with mineral acids, generally abound in soils. From the decomposition of basaltic, porphyritic †, and granitic rocks, there is a constant supply of earthy alkaline and ferruginous materials to the surface of the earth. In the sap of all plants that have been examined, certain neutrosaline compounds, containing potash, or soda, or iron, have been found. From plants they may be supplied to animals. And the chemical tendency of organization seems to be, rather to combine substances into more complicated and

stated to have been purified by washing in muriatic acid; but such a process was insufficient to deprive it of substances which might afford carbon, or various inflammable matters. Carbonaceous matter exists in several stones which afford a whitish or greyish powder, and when in a stone, the quantity of carbonate of lime is very small in proportion to the other earthy ingredients; it is scarcely acted on by acids.

* Bakerian Lecture, 1806, p. 8.

† In the year 1804, for a particular purpose of geological enquiry, I made an analysis of the porcelain clay of St. Stevens, in Cornwall, which results from the decomposition of the feldspar of fine-grained granite. I could not detect in it the smallest quantity of alkali. In making some experiments on specimens of the uncompounded rock taken from beneath the surface, there were evident indications of the presence of a fixed alkali, which seemed to be potash. So that it is very probable that the decomposition depends on the operation of water and the carbonic acid of the atmosphere on the alkali forming a constituent part of the crystalline matter of the feldspar, which may disintegrate from being deprived of it.

diversified

diversified arrangements, than to reduce them into simple elements.

VIII. *On the Nature of Ammonia and Alkaline Bodies in general; with Observations on some Prospects of Discovery offered by the preceding Facts.*

Ammonia is a substance, the chemical composition of which has always been considered of late years as most perfectly ascertained, and the apparent conversion of it into hydrogen and nitrogen, in the experiments of Scheele, Priestley, and the more refined and accurate experiments of Berthollet, had left no doubt of its nature in the minds of the most enlightened chemists.

All new facts must be accompanied, however, by a train of analogies, and often by suspicions with regard to the accuracy of former conclusions. As the two fixed alkalies contain a small quantity of oxygen united to peculiar bases, may not the volatile alkali likewise contain it? was a query which soon occurred to me in the course of enquiry; and in perusing the accounts of the various experiments made on the subject, some of which I had carefully repeated, I saw no reason to consider the circumstance as impossible. For, supposing hydrogen and nitrogen to exist in combination with oxygen in low proportion, this last principle might easily disappear in the analytical experiments of decomposition by heat and electricity, in water deposited upon the vessels employed or dissolved in the gases produced.

Of the existence of oxygen in volatile alkali I soon satisfied myself. When charcoal carefully burnt and freed from moisture was ignited by the Voltaic battery of the power of 250 of 6 and 4 inches square, in a small quantity

quantity of very pure ammoniacal gas * : a great expansion of the aëriform matter took place, and a white substance formed, which collected on the sides of the glass tube employed in the process ; and this matter, exposed to the action of diluted muriatic acid, effervesced, so that it was probably carbonate of ammonia.

A process of another kind offered still more decisive results. In this the two mercurial gazometers of the invention of Mr. Pepys, described in No. XIV. of the *Phil. Trans.* for 1807, were used with the same apparatus as that employed by Messrs. Allen and Pepys for the combustion of the diamond, and these gentlemen kindly assisted in the experiment.

Very pure ammoniacal gas was passed over iron wire ignited in a platina tube, and two curved glass tubes were so arranged as to be inserted into a freezing mixture ; and through one of these tubes the gas entered into the platina tube, and through the other it passed from the platina tube into the air-holder arranged for its reception.

The temperature of the atmosphere was 55° ; but it was observed that no sensible quantity of water was deposited in the cooled glass tube transmitting the unal-

* The apparatus in which this experiment was made is described in page 214, *Journal of the Royal Institution*. The gas was confined by mercury which had been previously boiled to expel any moisture that might adhere to it. The ammonia had been exposed to the action of dry pure potash, and a portion of it equal in volume to 10989 grains of mercury, when acted on by distilled water, left a residuum equal to nine grains of mercury only. So that the gas, there is every reason to believe, contained no foreign aëriform matter ; for even the minute residuum may be accounted for, by supposing it derived from air dissolved in the water.

tered ammonia, but in that receiving it after its exposure to heat moisture was very distinct, and the gas appeared in the air-holder densely clouded.

This circumstance seems distinctly to prove the formation of water in this operation for the decomposition of ammonia; unless indeed it be asserted that the hydrogen and nitrogen gasses evolved hold less water in solution or suspension than the ammonia decomposed; an idea strongly opposed by the conclusions of Mr. Dalton * and the experiments of Messrs. Desormes and Clement †.

After the gas had been passed several times through the ignited tube from one gazometer to the other, the results were examined. The iron-wire became converted superficially into oxyd, and had gained in weight $\frac{1}{11}$ parts of a grain; about four-tenths of a grain of water were collected from the cooled glass tubes by means of filtrating paper, and 33.8 cubic inches of gas were expanded into 55.3 cubic inches, and by denotation with oxygen it was found that the hydrogen gas in these was to the nitrogen as 3.2. to one volume.

It will be useless to enter into the more minute details of this experiment, as no perfectly accurate data for proportions can be gained from them; for the whole of the ammonia was not decomposed, and as the gas had been prepared by being sent from a heated mixture of sal ammoniac and quick-lime into the air-holder, it was possible that some solution of ammonia might have been deposited, which, by giving out new gas during the operation, would increase the absolute quantity of the material acted upon.

* Manchester Memoirs, vol. V. Part II. p. 535, 1785.

† Annales de Chemie, vol. XLII. p. 125.

In examining the results of M. Berthollet's,* elaborate experiments on the decomposition of ammonia by electricity, I was surprised to find that the weight of the hydrogen and nitrogen produced rather exceeded than fell short of that of the ammonia considered as decomposed, which was evidently contradictory to the idea of its containing oxygen. This circumstance, as well as the want of coincidence between the results and those of Priestley and Van Marum on the same subject, induced me to repeat the process of the electrization of ammonia; and I soon found that the quantities of the products in their relations to the apparent quantity of gas destroyed were influenced by many different causes.

Ammonia procured over dry mercury from a mixture of dry lime and muriate of ammonia, I found deposited moisture upon the sides of the vessel in which it was collected, and in passing the gas into the tube for electrization, it was not easy to avoid introducing some of this moisture, which must have been a saturated solution of ammonia, at the same time.

In my first trials made upon gas, passed immediately from the vessel in which it had been collected into the apparatus, I found the expansion of one of ammonia vary in different instances from 2.8 to 2.2 measures, but the proportions of the nitrogen and hydrogen appeared uniform, as determined by detonation of the mixed gas with oxygen, and nearly as one to three in volume.

To exclude free moisture entirely, I carefully prepared ammonia in a mercurial air-holder, and after it had been some hours at rest, passed a quantity of it into the tube for decomposition, which had been filled with

* Mémoires de l'Académie, 1785, p. 324.

dry mercury. In this case 50 parts became 103 parts by electrization, and there was still reason to suspect sources of error.

I had used iron wires not perfectly free from rust for taking the spark, and a black film from the mercury appeared on the sides of the tube. It was probable that some ammonia had been absorbed by the metallic oxyds both upon the iron and the mercury, which might again have been given out in the progress of the operation.

I now used recently distilled mercury, which did not leave the slightest film on the glass tube, and wires of platina. The ammonia had been exposed to dry caustic potash, and proved to be equally pure with that mentioned in page 191; 60 measures of it, each equal to a grain of water, were electrized till no farther expansion could be produced; the gas filled a space equal to that occupied by 108 grains of water. The thermometer in this experiment was at 56° , and the barometer at 30.1 inches. The wire of platina transmitting the spark was slightly tarnished *. The 108 measures of gas, carefully analyzed, were found to consist of 80 measures in volume of hydrogen, and 28 measures of nitrogen.

The results of an experiment that I made in 1799 † give the weight of 100 cubic inches of ammonia, as 18.18 grains at the mean temperature and pressure. I had reasons, however, for suspecting that this estimation might be somewhat too low; and on mentioning the circumstance to Messrs. Allen and Pepys, they kindly undertook the examination of the subject, and Mr.

* This most probably was owing to oxydation. When platina is made positive in the Voltaic circuit in contact with solution of ammonia it is rapidly corroded. This is an analogous instance.

† *Researches Chem. and Phil.* p. 62.

Allen soon furnished me with the following data. "In the first experiment 21 cubic inches of ammonia weighed 4.05 grains; in a second experiment the same quantity weighed 4.06 grains, barometer 30.65, thermometer 54° Fahrenheit."

Now if the corrections for temperature and pressure be made for these estimations, and a mean taken, 100 cubic inches of ammonia will weigh 18.67 grains, barometer being at 30, and thermometer at 60° Fahrenheit; and if the quantity used in the experiment of decomposition be calculated upon as cubic inches, 60 will weigh 11.2 grains. But the hydrogen gas evolved equal to 80 will weigh 1.93 * grains, and the nitrogen equal to 28 †, 8.3. And 11.2, grains — $1.9 + 8.3 = 10.2$ and $11.2 - 10.2 = 1$, all the estimations being made according to the standard temperature and pressure.

So that in this experiment on the decomposition of ammonia the weight of the gases evolved is less by nearly one-eleventh than that of the ammonia employed; and this loss can only be ascribed to the existence of oxygen in the alkali; part of which probably combined with the platina wires employed for electrization, and part with hydrogen.

After these ideas the oxygen in ammonia cannot well be estimated at less than seven to eight parts in the hundred; and it possibly exists in a larger proportion as the gases evolved may contain more water than the gas de-

* Lavoisier's Elements, p. 569. A cubical inch of hydrogen is considered as weighing .0239.

† Researches Chem. and Phil. p. 9. From my experiments 100 cubical inches of nitrogen weigh at the standard temperature and pressure 29.6 grains.

composed, which of course would increase their volume and their absolute weight *.

In supposing ammonia a triple compound of nitrogen, hydrogen, and oxygen, it is no less easy to give a rational account of the phenomena of its production and decomposition, than in adopting the generally received hypothesis of its composition.

Oxygen, hydrogen, and nitrogen are always present in cases in which volatile alkali is formed; and it usually appears during the decomposition of bodies in which oxygen is loosely attached, as in that of the compounds of oxygen and nitrogen dissolved in water.

At common temperatures, under favourable circumstances, the three elements may be conceived capable of combining and of remaining in union: but at the heat of ignition the affinity of hydrogen for oxygen prevails over the complex attraction, water is formed, and hydrogen and nitrogen are evolved; and, according to these conclusions, ammonia will bear the same relations to the fixed alkalies, as the vegetable acids with compound bases do to the mineral ones with simple bases.

Oxygen then may be considered as existing in, and as forming an element in all the true alkalies; and the principle of acidity of the French nomenclature, might now likewise be called the principle of alkalescence.

From analogy alone it is reasonable to expect that the alkaline earths are compounds of a similar nature to the fixed alkalies, peculiar highly combustible metallic bases united to oxygen. I have tried some experiments

* In the present state of our knowledge, perfectly correct data for proportions cannot probably be gained in any experiments on the decomposition of ammonia, as it seems impossible to ascertain the absolute quantity of water in this gas; for electrization, according to Dr. Henry's ingenious researches, offers the only means known of ascertaining the quantity of water in gases.

upon

upon barytes and strontites ; and they go far towards proving that this must be the case. When barytes and strontites, moistened with water, were acted upon by the power of the battery of 250 of 4 and 6, there was a vivid action and a brilliant light at both points of communication, and an inflammation at the negative point.

In these cases the water might possibly have interfered. Other experiments gave, however, more distinct results.

Barytes and strontites, even when heated to intense whiteness in the electrical circuit by a flame supported by oxygen gas, are non-conductors ; but by means of combination with a very small quantity of boracic acid they become conductors ; and in this case inflammable matter, which burns with a deep red light in each instance, is produced from them at the negative surface. The high temperature has prevented the success of attempts to collect this substance ; but there is much reason to believe that it is the basis of the alkaline earth employed.

Barytes and strontites have the strongest relations to the fixed alkalies of any of the earthy bodies * ; but there is a chain of resemblances, through lime, magnesia, glucina, alumina, and silex. And by the agencies of

* The similarity between the properties of earths and metallic oxyds was noticed in the early periods of Chemistry. The poisonous nature of barytes, and the great specific gravity of this substance as well as of strontites, led Lavoisier to the conjecture, that they were of a metallic nature. That metals existed in the fixed alkalies seems, however, never to have been suspected. From their analogy to ammonia, nitrogen and hydrogen have been supposed to be amongst their elements. It is singular, with regard to this class of bodies, that those most unlike metallic oxyds are the first which have been demonstrated to be such.

batteries

batteries sufficiently strong, and by the application of proper circumstances, there is no small reason to hope, that even these refractory bodies will yield their elements to the methods of analysis by electrical attraction and repulsion.

In the electrical circuit we have a regular series of powers of decomposition, from an intensity of action so feeble as scarcely to destroy the weakest affinity existing between the parts of a saline neutral compound, to one sufficiently energetic to separate elements in the strongest degree of union, in bodies undecomposable under other circumstances.

When the powers are feeble, acids and alkalies, and acids and metallic oxyds, merely separate from each other; when they are increased to a certain degree, the common metallic oxyds and the compound acids are decomposed; and by means still more exalted, the alkalies yield their elements. And as far as our knowledge of the composition of bodies extends, all substances attracted by positive electricity are oxygen, or such as contain oxygen in excess; and all that are attracted by negative electricity are pure combustibles, or such as consist chiefly of combustible matter.

The idea of muriatic acid, fluoric acid, and boracic acid containing oxygen, is highly strengthened by these facts. And the general principle confirms the conjecture just stated concerning the nature of the earths.

In the electrization of boracic acid moistened with water, I find that a dark-coloured combustible matter is evolved at the negative surface; but the researches upon the alkalies have prevented me from pursuing this fact, which seems, however, to indicate a decomposition.

Muriatic

Muriatic acid and fluoric acid in their gaseous states are non-conductors ; and as there is every reason to believe that their bases have a stronger attraction for oxygen than water, there can be little hope of decomposing them in their aqueous solutions, even by the highest powers. In the electrization of some of their combinations there is, however, a probability of success.

An immense variety of objects of research is presented in the powers and affinities of the new metals produced from the alkalies.

In themselves they will undoubtedly prove powerful agents for analysis ; and having an affinity for oxygen stronger than any other known substances, they may possibly supersede the application of electricity to some of the undecomposed bodies.

The basis of potash I find oxydates in carbonic acid, and decomposes it, and produces charcoal when heated in contact with carbonate of lime. It likewise oxydates in muriatic acid ; but I have had no opportunity of making the experiment with sufficient precision to ascertain the results.

In sciences kindred to chemistry, the knowledge of the nature of the alkalies, and the analogies arising in consequence, will open many new views ; they may lead to the solution of many problems in geology, and shew that agents may have operated in the formation of rocks and earths which have not hitherto been suspected to exist.

It would be easy to pursue the speculative part of this enquiry to a great extent ; but I shall refrain from so occupying the time of the Society, as the tenour of my object in this lecture has not been to state hypotheses, but to bring forward a new series of facts.

An

*An Account of a Method of hastening the Maturation of
Grapes. By JOHN WILLIAMS, Esq.*

*In a Letter to the Rt. Hon. Sir JOSEPH BANKS, Bart.
K. B. P. R. S. &c.*

From the TRANSACTIONS of the HORTICULTURAL
SOCIETY of LONDON.

IT is a fact well known to gardeners, that *vines*, when exposed in this climate to the open air, although trained to walls with Southern aspects, and having every advantage of judicious culture, yet in the ordinary course of our seasons ripen their fruit with difficulty. This remark, however, though true in general, admits of some exceptions, for I have occasionally seen trees of the common *white muscadine*, and *black cluster grapes*, that have matured their fruit very well, and earlier by a fortnight or three weeks, than others of the same kinds, and apparently possessing similar advantages of soil and aspect.

The *vines* that ripened the fruit thus early, I have generally remarked, were old trees having trunks eight or ten feet high, before their bearing branches commenced. It occurred to me, that this disposition to ripen early might be occasioned by the dryness and rigidity of the vessels of the old trunk, obstructing the circulation of that portion of the sap, which is supposed to descend from the leaf. And to prove whether or not my conjectures were correct, I made incisions through the bark on the trunks of several vines growing in my garden, removing a circle of bark from each, and thus leaving the naked alburnum above an inch in width completely exposed ; this was done in the months

of

of June and July. The following autumn the fruit growing on these trees came to great perfection, having ripened from a fortnight to three weeks earlier than usual: but in the succeeding spring, the vines did not shoot with their accustomed vigour, and I found that I had injured them by exposing the alburnum unnecessarily.

Last summer these experiments were repeated; at the end of July and beginning of August, I took annular excisions of bark from the trunks of several of my vines, and that the exposed alburnum might be again covered with new bark by the end of autumn, the removed circles were made rather less than a quarter of an inch in width. Two vines of the *white frontiniac*, in similar states of growth, being trained near to each other on a South wall, were selected for trial; one of these was experimented on (if I may use the term), the other was left in its natural state, to form a standard of comparison. When the circle of bark had been removed about a fortnight, the berries on the experimented tree began evidently to swell faster than those on the other, and by the beginning of September showed indications of approaching ripeness, while the fruit of the unexperimented tree continued green and small. In the beginning of October the fruit on the tree that had the bark removed from it, was quite ripe, the other only just began to show a disposition to ripen, for the bunches were shortly afterwards destroyed by the autumnal frosts. In every case in which circles of bark were removed, I invariably found that the fruit not only ripened earlier, but the berries were considerably larger than usual, and more highly flavoured.

The effects thus produced, I can account for only, by adopting Mr. Knight's theory of the downward circulation of the sap, the truth of which these experiments, in my opinion, tend strongly to confirm. I therefore imagine by cutting through the cortex and liber without wounding the alburnum, that the descent of that portion of the sap which has undergone preparation in the leaf is obstructed and confined in the branches situated above the incision; consequently the fruit is better nourished, and its maturation hastened. It is certainly a considerable point gained in the culture of the vine, to be able to bring the fruit to perfection, by a process so simple, and so easily performed. But lest there should be any misconception in the foregoing statement, I will briefly describe the exact method to be followed by any person, who may be desirous of trying this mode of ripening grapes. The best time for performing the operation on vines growing in the open air, is towards the end of July, or beginning of August; and it is a material point, not to let the removed circle of bark be too wide: from one to two-eighths of an inch will be a space of sufficient width; the exposed alburnum will then be covered again with new bark before the following winter, so that there will be no danger of injuring the future health of the tree.

It is not of much consequence in what part of the tree the incision is made, but in case the trunk is very large, I should then recommend, that the circles be made in the smaller branches.

It is to be observed that all shoots which come out from the root of the vine, or from the front of the trunk situated below the incision, must be removed as often

as

as they appear, unless bearing wood is particularly wanted to fill up the lower part of the wall, in which case one or two shoots may be left.

Vines growing in forcing houses are equally improved in point of size and flavour, as well as made to ripen earlier by taking away circles of bark : the time for doing this, is when the fruit is set, and the berries are about the size of small shot. The removed circles may here be made wider than on vines growing in the open air, as the bark is sooner renewed in forcing-houses, owing to the warmth and moisture in those places. Half an inch will not be too great a width to take off in a circle from a vigorous growing vine, but I do not recommend the operation to be performed at all in weak trees.

I think that this practice may be extended to other fruits, so as to hasten their maturity, especially *figs*, in which there is a most abundant flow of returning sap ; and it demonstrates to us, why old trees are more disposed to bear fruit than young ones. Miller informs us, that the vineyards in Italy are thought to improve every year by age, till they are fifty years old. It therefore appears to me, that nature, in the course of time, produces effects similar to what I have above recommended to be done by art. For, as trees become old, the returning vessels do not convey the sap into the roots, with the same facility they did when young : thus by occasionally removing circles of bark, we only anticipate the process of nature ; in both cases a stagnation of the true sap is obtained in the fruiting branches, and the redundant nutriment then passes into the fruit.

I have sometimes found that after the circle of bark has been removed, " a small portion of the inner bark

204 *Description of a Capstan, which works without*

has adhered to the alburnum :” it is of the utmost importance to remove this, though ever so small, otherwise in a very short space of time, the communication is again established with the root, and little or no effect produced. Therefore in about ten days after the first operation has been performed, I generally look at the part from whence the bark was removed, and separate any small portion, which may have escaped the knife the first time.

Description of a Capstan, which works without requiring the Messenger or Cable round it to be ever surged,

By JOHN WHITLEY BOSWELL, Esq.

With an Engraving.

From the TRANSACTIONS of the SOCIETY for the Encouragement of ARTS, MANUFACTURES, and COMMERCE.

The Gold Medal was presented to Mr. BOSWELL for this Invention.

AS few but mariners understand the manner in which cables are hawled aboard in large ships, it will probably render the object of my capstan more manifest, to give some account of this operation.—Cables above a certain diameter are too inflexible to admit of being coiled round a capstan ; in ships where cables of such large dimensions are necessary, a smaller cable is employed for this purpose, which is called the *messenger*, the two ends of which are made fast together so as to form an endless rope, which, as the capstan is turned out, revolves round it in unceasing succession, passing on its course to the head of the ship, and again returning to the capstan. To this returning part of the messenger the

the great cable is made fast by a number of small ropes, called nippers, placed at regular intervals; these nippers are applied as the cable enters the hawse-hole, and are again removed as it approaches the capstan, after which it is lowered into the cable tier.

The messenger, or any other rope coiled round the capstan, must descend a space at every revolution equal to the diameter of the rope or cable used; this circumstance brings the coils in a few turns to the bottom of the capstan, when it can no longer be turned round, till the coils are loosened and raised up to its other extremity, after which the motion proceeds as before. This operation of shifting the place of the coils of the messenger on the capstan, is called *surging the messenger*: it always causes considerable delay; and when the messenger chanches to slip in changing its position, which sometimes happens, no small danger is incurred by those who are employed about the capstan.

The first method that I know of used to prevent the necessity of surging, was by placing an horizontal roller beneath the messenger, where it first entered on the capstan, so supported by a frame, in which it turned on gudgeons, that the messenger in passing over it was compelled to force upwards all the coils above the capstan, as it formed a new coil.

This violent forcing of the coils upwards along the barrel of the capstan, not only adds considerably to the labour in turning the capstan, but from the great friction which the messenger must suffer in the operation while pressed so hard against the capstan, (as it must be by the weight of the anchor and strain of the men,) could not but cause a very great wear and injury to the messenger, or other cable wound round the capstan;

and

and that this wear must occasion an expense of no small amount, must be manifest on considering the large sums which the smallest cables used for this purpose cost.

The next method applied to prevent surging, was that for which Mr. Plucknet obtained a patent, the specification of which may be seen in the Repertory of Arts, No. 46. In this way a number of upright puppets or lifters, placed round the capstan, were made to rise in succession, as the capstan turned round by a circular inclined plane placed beneath them, over which their lower extremities moved on friction wheels, and these puppets, as they rose, forced upwards the coils of the messenger on the barrel of the capstan. This was a superior method to the first, as the operation of forcing upwards the coils was performed more gradually by it; but still the wear of the messenger from the lateral friction in rising against the whelps of the capstan remain undiminished.

The third method used for the same purpose was that proposed by Captain Hamilton. It consisted in giving the capstan a conical shape, with an angle so obtuse, that the strain of the messenger forced the coils to ascend along the sloped sides of the barrel. The roller first mentioned was sometimes used with this capstan, of which a full account is inserted in the Repertory of Arts, vol. II. Second Series. The lateral friction and wear of the messenger against the whelps of the capstan is equally great in this method as in the others; and it besides has the inconvenience of causing the coils to become loose as they ascend; for as the upper part of the barrel is near a third less in diameter than the lower part, the round of the messenger that tightly embraced the

the lower part must exceed the circumference of the upper extremity in the same proportion.

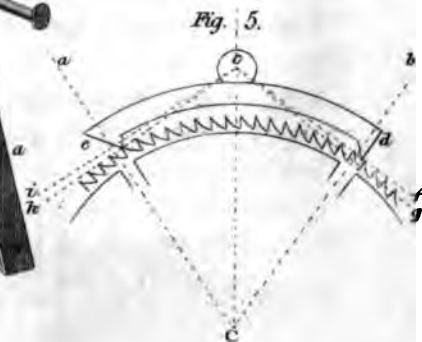
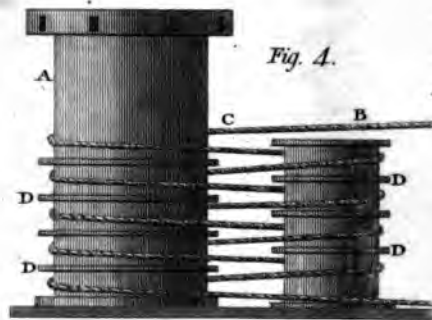
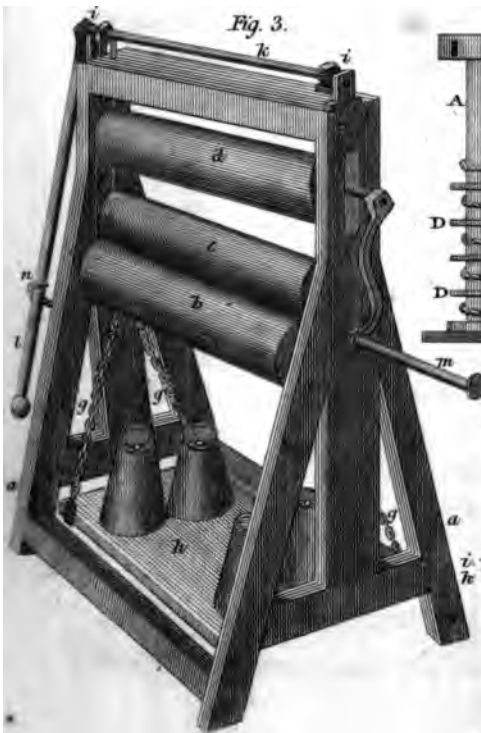
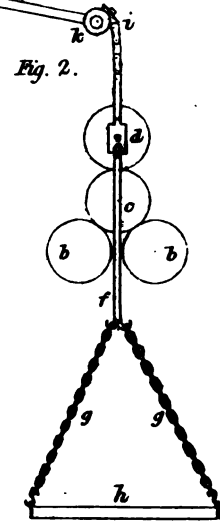
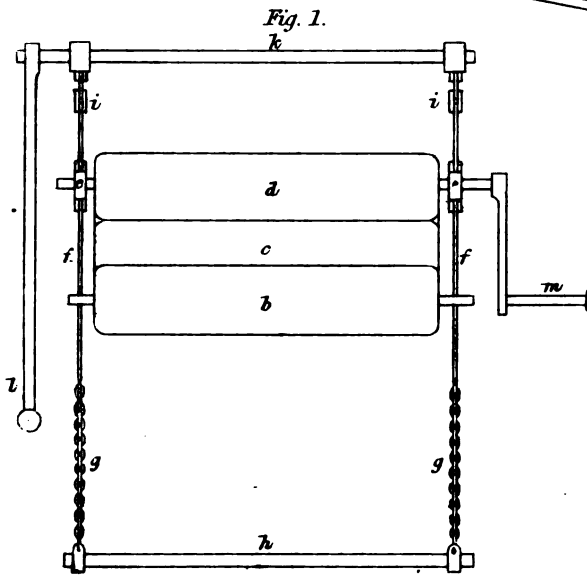
In the method of preventing the necessity of surging, which the model I have had the honour of laying before the Society represents, none of the lateral friction of the messenger or cable against the whelps of the capstan (which all the other methods of effecting the same purpose before mentioned labour under) can possibly take place, and of course the wear of the messenger occasioned thereby will be entirely avoided in it, while it performs its purpose more smoothly, equally, and with a less moving power than any of them.

My method of preventing the necessity of surging consists in the simple addition of a second smaller barrel or capstan of less dimensions to the large one; besides which, it is to be placed in a similar manner, and which need not in general exceed the size of an half-barrel cask: the coils of the messenger are to be passed alternately round the large capstan and this small barrel, but with their direction reversed on the different barrels, so that they may cross each other in the interval between the barrels, in order that they may have the more extensive contact with, and better gripe on, each barrel. To keep the coils distinct, and prevent their touching each other in passing from one barrel to the other, projecting rings are fastened round each barrel, at a distance from each other equal to about two diameters of the messenger and the thickness of the ring. Those rings should be so fixed on the two barrels, that those on one barrel should be exactly opposite the middle of the intervals between those on the other barrel: and this is the only circumstance which requires any particular attention in the construction of this capstan. The rings should

should project about as much as the cable or messenger from the barrels, which may be formed with whelps, and in every other respect, not before mentioned, in the usual manner for capstan barrels, only that I would recommend the whelps to be formed without any inclination inwards at the top, but to stand upright all round, so as to form the body of the capstan in the shape of a polygonal prism, if the intervals between the whelps are filled up, in order that the coils may have equal tension at the top and at the bottom of the barrels, and that the defect which conical barrels cause in this respect may be avoided.

The small barrel should be furnished with falling palls as well as large ones; a fixed iron spindle ascending from the deck will be the best for it, as it will take up less room. This spindle may be secured below the deck, so as to bear any strain, as the small barrel need not be much above half the height of the large barrel; the capstan bars can easily pass over it in heaving round, when it is thought fit to use capstan bars on the same deck with the small barrel. As two turns of the messenger round both barrels will be at least equivalent to three turns round the common capstan, it will hardly ever be necessary to use more than four turns round the two barrels.

The circumstance which prevents the lateral friction of the messenger in my double capstan is, that in it each coil is kept distinct from the rest, and must pass on to the second barrel before it can gain the next elevation on the first, by which no one coil can have any influence in raising or depressing another; and what each separate coil descends in a single revolution it regains as much as is necessary in its passage between the barrels, where



where in the air, and free from all contact with any part of the apparatus, it attains an higher elevation without a possibility of friction or wear.

I have described my double capstan as it is to be used in large vessels, where messengers are necessary, from the great size of the cables ; but it is obvious that it is equally applicable to smaller vessels, as their cables can be managed with it in the same manner as is directed for the messenger. The same principle may also be easily applied in windlasses, by having a small horizontal barrel placed parallel to the body of the windlass, and having both fitted with rings, in the same way as the capstan already described. The proper place for the small horizontal barrel is forward, just before the windlass, and as much below its level as circumstances will admit ; it should be furnished with catch-palls as well as the windlass.

Besides the advantages already stated, my proposed improvement to the capstan has others of considerable utility. Its construction is so very simple, that it is no more liable to derangement or injury than the capstan itself. Its cost can be but small, and every part of it can be made by a common ship carpenter, and be repaired by him at sea if damaged by shot. It will take up but little room, only that of a half-barrel cask ; and it is of a nature so analogous to that kind of machinery to which sailors are accustomed, that it can be readily understood and managed by them.

In order to render the description of my double capstan more clear, I annex a sketch of it, as fitted up in the manner proposed.

210 *On the Construction of the Teeth of Escapements.*

*Reference to the Engraving of Mr. BOSWELL's improved
Capstan, to prevent the Necessity of Surging.*

(Plate VIII. Fig. 4.)

A, represents the larger or common capstan used on board ships.

B, another capstan of less dimensions, placed in a similar manner.

C, the coils of the messenger passing alternately round the large and small capstans, but with their direction reversed on the different barrels, so that they may cross each other in the interval between them.

D D D D, projecting rings round each capstan or barrel, so fixed on the two barrels, that those on one barrel should be exactly opposite the middle of the intervals between those on the other barrel.

On the Construction of the Teeth of Escapements.

With an Engraving.

*Communicated by Mr. ROBERT KING, of Scarborough,
in a Letter to the Editors.*

GENTLEMEN,

IN order that the principle for the escapement of pallets, as given in my last paper, inserted in your 71st number, may be clearly understood, and more easily applied to wheels of different numbers of teeth, and to pendulums of different lengths, a farther illustration may be made, in observing, that as Mr. Ferguson, in his *Select Exercises*, proposes a clock of a very simple construction, but seems apprehensive that it would be difficult to make an escapement for his wheel of 90 teeth with

with proper motion ; it may not be improper to shew how that escapement may be effected. We are to observe, that the impulsive angle or half-swing of the pendulum of the clock is nearly half a tooth ; and so by taking fewer teeth, or shortening the extent of the fangs or inclined planes so as to be nearer the centre of the verge, the vibrations may be increased at pleasure. For as the proposed swing or vibration from the centre of the swing in the pendulum is to half a tooth the impulsive angle on the pallets, so is the length of the pendulum to the distance of the point of percussion on the plain of the pallet to its distance from its centre or the verge of the pallets ; so that you must make the pallets to escape such a number of teeth as will give the proposed vibration. To effect this, the following shews the method at large. Ferguson's clock having a swing-wheel of two inches and a quarter diameter, the circumference will be .70686 inches ; and being to have 90 teeth, each tooth will be .07854 of an inch, and the half tooth ,03927 of an inch. And the pendulum being designed to beat seconds, will in this part of the world be nearly 39,2 inches in length. Now, suppose I should wish to apply it with four inches vibration, it would then vibrate two inches on each side of the centre ; then the proportion would stand as two inches the vibration on one side of the perpendicular is to the length of the whole pendulum, or 39,2 so is ,03927 the space taken up by half a tooth, or the length of the line impulse, on the face of the pallet (which will be near enough ; it allowing a small drop of the difference between the slope and its perpendicular for inequalities of workmanship) to 744692 of an inch, or half the opening of the pallets, or the distance from the point of impulse to the centre

of the verge. This being the tangent of half the angle included between the points of impulse, the angle at the centre will be found, by trigonometry, to be $35^{\circ} 50'$; so that the whole opening of the pallets for that swing or vibration will be 67 degrees, which would be near seventeen teeth; and as the pallets must always have an extent of half a tooth more in the opening, they will require in this case seventeen teeth and a half, which will make the opening of the pallets take in 70 degrees of the circumference of the wheel, being the extent to the next largest half tooth.

To draw the escapement, from the centre C (Fig. 5, Plate VIII.) draw the perpendicular Cc, and on each side of it set off the angle of 35° , which is the angle of scapement, and draw the lines a C and b C. Then draw the pallet d, and from the centre of the verge at c through the point of impulse draw the line cf. Then through the point of escape draw the line cg. Then from the line of escape through the point of the other pallet e draw the line eh; the line of escape of that pallet; from which line setting off the angle of impulse ich equal to the angle fcg , it will give the point of impulse on the pallet e; this method may be taken for short pendulums also; when the opening of the pallets in consequence will grow less as the pendulum is shortened and the swing increased, as must be the case for half seconds; so that the pallets perhaps may not take in above two or three teeth and a half, as for table-clocks, &c. I am, Gentlemen,

Yours, &c.

R. KING.

Description

Description of a Threshing Machine, made by Mr. JOSEPH FROST, of Great Linford, near Newport Pagnel, Bucks.

Communicated by a Correspondent, in a Letter to the Editors.

THIS machine consists of a horse-wheel, of about twelve feet diameter, on a perpendicular shaft, which is entirely of wood, and turns a pinion of cast-iron on one extremity of a horizontal shaft, which has a larger iron wheel at the other extremity, working in the pinion of the threshing-drum; on the spindle of which is fixed another wheel, to work two fluted rollers for regulating the supply of corn.

Thus with three movements only the threshing-drum is put into motion, and made to perform nearly five hundred revolutions in a minute; and being furnished with twenty-ribs, about ten thousand blows are struck in the same time.

The horse part of the machine is erected withoutside of the barn, and may be covered with a shed or hovel; and the threshing part, which is withinside the barn, occupies a space of four feet wide by seven feet long, and may be covered over at nine or ten feet high. It may be worked by either one or two horses, at discretion; if with one horse, it will thresh full fifty bushels of corn in a day of nine hours, and more than eighty bushels if two horses are employed. The straw is less injured than if threshed with a flail; the men employed in either case are three only, and a boy to drive the horse: but if the corn be not previously bound in
sheaves

sheaves it becomes necessary to put it *twice* through the machine; otherwise one threshing will give the straw entirely clean,

The expense of this machine, including all materials of wood, iron, and brass, is not exceeding ninety pounds, exclusive of carriage, and the board and lodging of four workmen for a fortnight while employed in fixing it up. It has been erected for many farmers in the midland counties without failing or being disapproved of afterwards in any one instance; and in the neighbourhood of the metropolis, for Edmund Morris, Esq. of Charleywood, near Rickmersworth; for Mr. Field of Chesham; and for Mr. Pickford of Market-street; the last of whom has erected a second machine, with which he has combined a chaff-cutter, and a pair of mill-stones, and finds them all perform satisfactory, one horse being added whenever each of these is put to work.

List of Patents for Inventions, &c.

(Continued from Page 144.)

THOMAS SMITH the younger, of Capon Field Iron-works, near Bilston, in the county of Stafford, Iron-master; for certain improvements in steam-engines. Dated June 3, 1808. Specification to be enrolled within one month.

RALPH DODD, of Change Alley, in the city of London, Engineer; for improved bridge floorings or platforms, and fire-proof floorings and fire-proof roofings for extensive dwelling-houses, warehouses, and mills. Dated June 3, 1808. Specification to be enrolled within six months.

WILLIAM SHOTWELL, of the city of New York, in North America, now residing in the parish of St. Mary Lambeth, in the county of Surrey, Gentleman; for certain improvements in the manufacturing of mustard. Communicated to him by a foreigner residing abroad. Dated June 14, 1808. Specification to be enrolled within six months.

GEORGE TENNANT, of Great Ormond-street, in the county of Middlesex, Gentleman, and **ALEXANDER GALLOWAY**, of Holborn, in the same county, Mechanist; for a machine or machines for cutting all sorts of fustians, usually denominated constitution cord, tabby cord, shaft cord, thickset, tabby velveteen, Genoa velveteen, veleret, and every other species of fustian, veleret, and velveteen; also velvet, plush, and other cloths or goods.

goods made of cotton, silk, woollen, or any mixture thereof, usually cut in the manufacture of such articles. Dated June 14, 1808. Specification to be enrolled within six months.

GEORGE LOWE, of Cheapside, in the city of London, Cotton-spinner; for an improvement in the manufacture of a fabric, composed of flax and cotton, which is applicable to many useful purposes. Dated June 23, 1808. Specification to be enrolled within six months.

SAMUEL GADD, of Shadwell, in the county of Middlesex, Rope-maker; for an improvement in the art of rope-making, upon the principle of composing each strand of rope with two distinct threads twisted together, and of the arrangement of the apparatus by which that principle is carried into effect. Dated June 25, 1808. Specification to be enrolled within one month.

JOHN HALL, of the town and county of the town of Kingston-upon-Hull, Rope-maker; for certain improvements in making and manufacturing ropes and other cordage, and coiling of lines in whale boats. Dated June 28, 1808. Specification to be enrolled within one month.

GEORGE POCOCK, of the city of Bristol, Schoolmaster; for geographical slates for the construction of maps. Dated June 28, 1808. Specification to be enrolled within one month.

THE
REPERTORY
OF
ARTS, MANUFACTURES,
AND
AGRICULTURE.

No. LXXVI. SECOND SERIES. Sept. 1808.

Specification, enrolled pursuant to Act of Parliament of the 47th of GEORGE the Third, of the Invention of HENRY FOURDRINIER and SEALY FOURDRINIER, of Sherborne Lane, London, and JOHN GAMBLE, of Saint Neots, in the County of Huntingdon, Paper Manufacturers; for making Paper by Means of Machines, for which several Letters Patent have been obtained at different Periods.

Term extended to 15 Years from August 14, 1807.

With Plates.

TO all to whom these presents shall come, &c.
NOW KNOW YE, that in compliance with the terms and conditions of a certain Act of Parliament passed in the now last Session of Parliament, and intituled, "An Act for prolonging the term of certain Letters Patent assigned to Henry Fourdrinier and Sealy Fourdrinier, for the invention of making paper by means of machines;" we do describe and ascertain the nature of the machine and invention in the said Act mentioned, in the present improved state thereof, and in what manner the said

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machine is to be made and used in such improved state, and also in what manner the work to be done thereby is to be performed; and we do also herein explain such better practical application of the original and improved principle or principles of the said machine and invention described in the specifications inrolled, as in the said Act is mentioned, or any or either of them, together with all the improvements thereof, as we ourselves do now use and practise. And accordingly we do describe the nature of our said machine and invention in the present improved state thereof; and do declare that the same consists in the using a revolving web of wove wire, or other similar material or thing applicable in like manner as such web; the same being made endless by joining its ends together similar to a round towel, or by having it wove endless, and in applying such web to the making or manufacturing of paper, according to the arrangement and application of the revolving or endless web before-mentioned, in connection with other mechanical apparatus, as hereinafter more particularly described.

First, the pulp or material of which the paper is intended to be made, having been prepared in the usual way, well known to paper manufacturers, is deposited in a proper receptacle, such as is generally called the vat, marked VAT in N° 1 of the drawings accompanying this specification (see Plate IX.) The said drawing, N° 1, exhibits a side view or elevation of the said machine, and also a plan thereof; and for the purpose of better elucidation, we have indicated the same things in each by the same letters or figures of reference. The pulp being in the said vat is, by admixture of water therewith, brought to the required consistency, and is then suf-
fered

ferred to run through certain apertures in the side or front of the vat at A, and conducted from thence by an inclined plane B B, in an uniform stream upon the surface of the revolving web *a a a*, &c. which is so placed, that its surface * shall be as nearly level as possible, and shall have its revolving motion in the direction in which the stream of pulp runs from the vat. This web is kept extended longitudinally by two principal or extreme rollers, C and E, upon which it revolves; and the upper part thereof, upon which the paper is formed, is supported and kept level by a number of small rollers *b b b b*; and other smaller ones hereinafter described, placed parallel with the other two C and E, and at such distances from each other as to prevent the web from being pressed or weighed down by the pulp into the spaces between them, and also to cause the pulp to spread itself uniformly upon the surface of the web or sheet, thereby producing a sheet of paper of an uniform thickness. The web is likewise kept extended laterally by means hereinafter explained. The width of the sheet of paper is determined by two pieces of wood set edgewise upon the web, exactly parallel with each other, and with the line of motion of the web. These pieces require no particular precision as to their dimensions, but we generally make them about three inches in depth, one inch and a quarter thick, and about four feet long, extending from that part of the web which is next the vat, in the direction of the line of motion. Between, and in contact as well with the under edges of these pieces as with the upper surface of the web, we place two endless straps of leather of a width corresponding to the

* This level surface or horizontal position we continue from C to D, two of the rollers supporting the said web or sheet.

thickness of the pieces ; and cause them to revolve upon pulleys with a velocity exactly equal to the velocity of the revolving web. We likewise place similar pieces and straps in contact with the under surface of the web, and exactly opposite to those upon the upper surface ; so that the web is pressed between the upper and under straps and pieces, and the liquid pulp is thereby prevented from running off towards the sides. These pieces and their straps we call dickles [F and G are the pieces, and H and I are the straps]. Near that part of the web upon which the pulp falls from the inclined plane at C, and between it and the vat, we place a flap of oiled silk or other flexible material ; but we use silk, one edge of which rests upon the web, the other being fastened to a piece of wood laid across the surface of the web, but not touching it, the length of the said piece corresponding to the width between, and being supported at each end by the dickles. The flap of oiled silk is to prevent the pulp from running back towards the vat. Between the two principal or extreme rollers C and E, upon which the web revolves, and about two feet and a half from E, and between that and the vat, we place two other rollers or cylinders J and K, one above the other, and cause the upper part of the web with the paper forming thereon, to pass between them for the purpose of pressing out the water ; and from this use of them, we distinguish them by the denomination of the first or wet press cylinders or rollers. In order to guard the pulp, which before passing between the cylinders is yet in a soft state, from being dislodged or otherwise injured by the upper roller or cylinder J coming immediately in contact with it, we use another revolving web of wove wire or other fit material, which in this case may
be

be of felting, as at *d d d d*, of the same width as the one above-mentioned, but not so long. To distinguish which last-mentioned web from the other web before-mentioned, we shall call the first-mentioned web by the name of the under web, and the web now describing we shall call the upper web: the bottom part of the said upper web we likewise cause to pass between the two cylinders J and K, so that its under surface falls upon the surface of the pulp or paper, and defends it from the action of the upper cylinder J. This upper web is kept extended by, and made to revolve upon, two rollers L and M, placed one on each side of the wet press cylinder J and K, and at a convenient height above them. The wet press cylinders are provided with a compressing apparatus at each end, to give the necessary pressure to the paper.

It is evident then, that, if motion is given in the proper direction to the wet press cylinders J and K, having both the webs thus compressed between them, such webs will be drawn along by them, and caused to revolve upon their respective rollers; and that as long as these webs continue so to revolve, and the pulp continues supplied and running upon the surface of the under web, so long will the machine continue making a sheet of paper of continually increasing length.

But as the paper after having passed between the first press cylinders, has not obtained such a degree of consistency and strength, as to allow of its being removed from the machine, and cut into sheets and laid in packs; we therefore cause it to pass through a second pair of pressing cylinders N and O, which we denominate the second or dry press, where it receives such a further degree of pressure and consequent strength, as to fit it
for

for all the subsequent operations necessary to finishing it for market. The second or dry press consists of a pair of cylinders adapted to strong pressure, and which, therefore, we make of hard metal (preferring brass as not liable to rust), which cylinders, N and O, are turned perfectly true and smooth, and placed one above the other at a convenient distance from and exactly parallel with the first press cylinders. Between these, *viz.* the second press cylinders N and O, we place the upper part of a revolving web of flannel or felting, or other fit material (represented by the lines at *eeee*, and hereinafter called generally the felting) by way of distinction from the upper and under webs before-mentioned; and we cause such felting to revolve upon and to be kept extended by two rollers P and Q, one on each side of the cylinders N and O; and by giving motion to those cylinders N and O, we cause the felting to revolve upon its rollers P and Q, in the same direction and with the same velocity as the under web. And we cause the paper after it has passed the first press, and arrived at the extreme roller E, upon which the web revolves, to be detached from the surface of the web, and to be deposited upon the revolving felting, and with it made to pass between the second press cylinders. The paper is then collected and wound upon reels or rollers as at R, which are successively removed and others applied as they become charged or filled with paper. The long sheets of paper thus obtained are, by a subsequent process hereinafter described, cut into others of the required dimensions.

Having thus far described and ascertained the nature and principle of our said machine and invention in its improved state, and the other particulars required to be explained

as herein before recited, we do as follows, further and more particularly describe and ascertain in what manner the work to be done by our said machine and invention is to be performed, together with all the improvements thereof as we ourselves do now use, and practise the same, that is to say: We construct the vat or vessel in which the paper stuff or pulp is deposited previous to its being made into sheets of paper, of wood, and of a rectangular figure as of the most convenient material and form, a plan and section of which is seen in No. 1 of the drawings accompanying this specification, and marked VAT. Against the front, or that side of the vat opposite to the under web and on the outside thereof, we affix a small trough, of a length nearly equal to the width of the said web as represented at S, into which the pulp or paper stuff is permitted to flow through several apertures in the side of the vat at equal distances from each other and from the top of the vat, as represented by the dotted lines A A A, &c. in the plan, and at A in the section. Into these apertures we usually insert brass or copper tubes, of a length equal to the thickness of the side of the vat into which they are so inserted. Against the side of the vat and upon or over the ends or orifices of these tubes, we place a sheet or plate of copper or brass, of a length and width sufficient to cover them; and in this plate we make as many holes as there are tubes, the diameter and situation of these holes exactly corresponding to the orifices of the tubes; and by making the plate to slide backward and forward, it is obvious that the communication between the vat and the trough S above mentioned, through the tubes, will be either opened or shut as the holes in the sliding plate are made to correspond with the apertures or ends of the tubes

tubes or otherwise ; or they may be partly open or partly shut in any intermediate degree, so that the quantity of pulp or paper stuff required to run from the vat upon the under web may by this means be regulated and adjusted to the velocity of the under web, as to produce a sheet of paper of any required thickness. We cause the pulp or paper stuff in the vat to be constantly stirred or agitated as long as the machine continues at work by certain pieces of mechanism commonly used in paper mills for that purpose, and well known to the manufacturers by the appellation of hogs; and these are represented at T T T T. The inclined plane B B, which is affixed to the upper edge of the trough in the front of the vat for the purpose of conducting the pulp from thence to the surface of the under web, is a copper plate hammered exceedingly flat and true, and otherwise reduced to as perfect a plane as possible. The pulp is prevented from spreading itself laterally, or running off sideways from the inclined plane, by proper pieces set edgeways thereon for that purpose. To prevent confusion in the drawing, we have shewn the inclined plane in the section only at B B and its support *f*, but its situation on the plan is denoted by the dotted lines B B B B. The upper edge of the trough over which the pulp flows upon the inclined plane at *g* should be exactly level, and about seven or eight inches below the upper edge of the vat, and about five inches above the surface of the under web. The required angle of the inclined plane will vary the quality and quantity of the pulp to be thrown upon the web, and must be ascertained by experiment. As the pulp ought to fall upon the under web with as little velocity as possible, we therefore place a small copper or wooden trough across the surface of the under web, and about half an inch
above

above it, and supported at each end by the dickles. The situation and figure of this trough (which we call the delivering trough) is shewn in the section at *c*, and likewise one of the regulating screws *U*, by which it is raised or lowered as the thickness of the paper may require, by having a screw at each end. By this means the rapidity of the pulp is considerably lessened by falling first into the trough and then upon the web. But it may still be further decreased by causing the flap of oiled silk to extend beyond and underneath the edge of the trough from which the pulp falls upon the silk and from thence runs gently upon the web. *V V V* is the wooden frame work supporting the various parts of the machinery. *J* and *K* the first or wet press cylinders or rollers with the revolving webs *a a*, &c. and *d d*, and passing between them, $\rightarrow$ are darts or arrows, denoting the direction in which the webs move. *W* and *X* the iron spindles of the cylinders, *h h* the iron carriages, and bearing brasses *i i*, in which the spindles of the cylinder are supported and turn, *k* the compressing screws by which the upper cylinder is forced down upon the under one, to give the necessary pressure to the paper. The upper part of the iron carriages *h h* is fastened to the under part by screws or otherwise, and may be detached therefrom at any time when it may be necessary to remove the cylinders from their places for the purpose of putting on new webs, &c. *L* and *M* are the two rollers upon which the upper web revolves, *Y* and *Y* are their supporters, in the upper ends of which are placed the pieces of brass *Z* and *Z**, which slide backward and forward, and in these pieces the pivots or

* The rollers *L* and *M*, and their supports *Y* and *Y*, are only shown in the section.

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screws in either direction by the teeth of the wheels taking into each other respectively. The roller C near the vat has its pivots resting upon, or turning in two carriages or supporters *s* and *s* affixed to a strong iron bar *t*, (which we call the shaking bar) supported by the two upright pieces of iron *u* and *u*, which are each connected with the shaking bar by a joint as at *v*, and with the frame at bottom by another joint at *w*. These joints admit of the bar being moved or shook backward and forward in a direction parallel with itself. The upright pieces or supports are furnished with screws near the bottom at *x*, by which the roller C and the under web may be set exactly level; *y y*, &c. are two straight iron bars, one on each side of the upper part of the under web, and parallel therewith, having their ends next the vat connected by means of a joint at *z*, with the iron carriages or supports *A a* placed upon and affixed to the shaking bar; the other end of the bars *y* and *y*, being in like manner connected with the iron carriages or supports *A b* and *A b* affixed to the wooden posts *A c*. These we call the ruler bars, and to them are attached a number of wheels *A d A d* &c. (the peculiar construction and application of which will be shewn hereafter) for the purpose of conducting the under web in a proper direction, and likewise for keeping the same extended laterally. Upon the ruler bars are supported the dickles, by means of the five cross bars marked *A e*; two of which pass through mortises made for that purpose in the upper dickles, and the other three through the under ones. *A f*, *A f*, &c. are screws by which the bars are connected to the ruler bars, and by which the upper and under dickles are adjusted and set parallel with each other, and with the under web. F and G are the dickles

with the revolving straps H and I. *Ak* and *Al* are the pullies, upon which the straps revolve; the pullies *Ak* and *Al* being made to revolve upon arbors or pins fixed to each dickle, as at *Al*. The dickles are kept parallel with and at any determinate distance from each other by the screws *Aj*, by which they are fastened or held to the cross bars *Ac*. In order to prevent the pulp from adhering to the dickles, we line or cover them with plates of copper or brass on both sides and upon that edge which bears upon the strap. *Ak* and *Al* are two toothed wheels of equal diameters, taking or working into each other, and fixed or hung upon the two spindles *Am* and *An*, as seen in the section. The wheel *Ak* and spindle *Am* are likewise shewn upon the plan. The spindles *Am* and *An* are placed across the machine, one above and the other below the upper part of the under web, for the purpose of communicating motion to the revolving straps by means of the wheels *Ao* and *Ap* and the pulley *Ag*, round which the strap revolves. The wheel *Ap* is concentric with and affixed to the side of the pulley *Ag*. The other wheel *Ao* is hung or fixed upon the spindle *Am*. The frame work or arm by which the wheels *Ao* and *Ap* are held in connection with each other is so constructed, that one end swings or turns upon the outside of the extended socket of the wheel *Ao*, through which the square spindle *Am* passes (the outside of the socket being made round for that purpose).

In the other end of the frame or arm we fasten a round pin or arbor, its axis being parallel with the spindle; and upon this pin the wheel and pulley *Ap* and *Ag* turn; the teeth of the two wheels *Ao* and *Ap* take in each other, so that in whatever direction the arm and wheel *Ap* turn or move, the centre of the wheel and pulley *Ap* and *Ag* will describe

describe a circle or part of a circle round the centre of the spindle, and the teeth of the two wheels continue to take in each other. By this means the pulley *Ag* not only gives motion to, but serves likewise to tighten the revolving straps when drawn back by the swivel-screws *Aq, Aq, Aq, Aq*. Whenever it is necessary to shift the dickles nearer to or farther from each other, in order to vary the width of the sheet of paper, the wheels and pullies must likewise be shifted upon the spindles, and again fastened thereon (by the wedge or key passing through the socket of each) in such a position as to bring the pullies *Ag* exactly opposite their respective dickles to which they belong.

In order to make the velocity of the strap correspond with the velocity of the web, we make the pullies *Ag, Ag*, of the same diameter as the wet press cylinders, which give motion to the web, and cause them to make the same number of revolutions.

Ar is a bevel wheel, hung upon the spindle of the cylinder *K*, the teeth of which take into those of the pinions *As*, hung upon the spindle *At*, having another pinion of equal size at *Au* upon the opposite end thereof, the teeth of which take into the bevel wheel *Av*, having an equal number of teeth with the wheel *Ar*, and is hung upon the dickle strap spindle *Ax*.

By inspecting the drawings and the relative disposition of the wheels, it will easily be seen that when the machine is in motion the straps will move in the proper direction. As it is a material point for the preservation of the web that the straps should move exactly with the same velocity as the web does, this must be ascertained by actual observation when the machine is in motion, and the diameter of the pullies must be corrected, if necessary,

necessary; and this precaution becomes the more indispensable as the wet press cylinders are covered with flannel, cloth, or felting, which renders their diameters indeterminate. This lining or covering upon the cylinders prevents them from injuring the web, and produces a better effect upon the paper than the naked cylinders would do. To prevent the ruler bars *y y y*, &c. from being bent down by the weight of the dickles, cross-bars, &c. resting upon them, we place two upright supports, *A w* and *A w*, under each of them, with joints and adjusting screws near the bottom at *A x*, by which the web is brought to a horizontal position, that is to say, so much of it as extends from the roller *C*, near the vat, to the roller *D*, over which it passes, and receives another direction, the use of which we shall hereafter explain. The rollers marked *B b*, &c. are for supporting the web, and keeping it level, having their spindles or pivots resting upon the brass bearings or carriages *A y*, affixed to the ruler-bars on each side of the machine, and made adjustable up and down, that the upper surfaces of the rollers may be brought level with each other. *A z*, &c. are a series of smaller rollers applied with the same intention as those last described, but having their bearings affixed to the inside of the under dickles. *B a* and *B a* are two brass cylinders or rollers, including between them the two webs, in the same manner as it is done by the press cylinders *J* and *K*, and are supported by their pivots or spindles turning in the brass carriages at *B b* and *B b*, one of which is seen in the section, the upper end being a screw, by which it is fastened by the two nuts *B d* and *B d* to the piece of iron *B c* affixed to the carriages of the cylinders; the piece of iron *B c*, having a longitudinal mortise

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tise therein, through which the screw passes, and admits of its being moved backward and forward therein so as to alter the situation of the rollers *B a* and *B a*, by bringing them nearer to or further from the press cylinders *J* and *K*, and by means of the screws *B c* they may be raised or lowered. The upper roller *B a* is held down or pressed against the under one by means of weights suspended from the axis at each end, thereby giving a certain pressure to the paper, and expelling a portion of the water, previous to the harder pressure given by the cylinders *J* and *K*. *B f* is a small roller resting upon the webs, and as near the upper cylinder *J* as may be, to allow of its revolving freely upon the webs without touching the cylinder. It is kept in its place by a piece at each end, as at *B g*, and prevents the water which is expelled by the cylinders *J* and *K* from flowing back upon the paper, which it otherwise would do. And it is for this purpose likewise that we cause the under web in its approach to the cylinders *J* and *K* to descend, as from *D*, to *J* and *K*.

The direction in which the under web is conducted on each side of the cylinders will be clearly understood by the sectional drawing. But note, that in this, as well as in every other place where the webs of wire or felting are mentioned, the same are to be supposed when the plan is inspected, because they could not be therein delineated without obscuring other parts.

Fig. 1 (Plate X.) in No. 2 of the drawings hereto annexed, is a section of the guide-wheels *H H*, by which we proceed more particularly to shew the method or manner by which the revolving webs and felting are kept extended laterally, and conducted in a proper direction. The line *A A* represents the web as extended across the machine
by

by the opposite guide wheels. B B are pieces of tape or leather sewed to each edge of the web A A. C C are two other thicker pieces of leather firmly sewed upon the edges of the former ones. D D a section of the ruler bars. G G the brass frame or carriage for the guide wheels, and is affixed to the ruler bar by the pin or key E E. The arbors or pins upon which the guide-wheels turn are made fast in the carriages at F F. The edges of the wheels are turned or made in the shape represented in the section, and being placed at such a distance from each other as to admit of the pieces of leather B B passing freely between the opposed parts thereof, do apply themselves to, and fill the angles made by the pieces of leather C and B. From hence it will be understood that the action of the wheels against the pieces of leather C C will be sufficient to give the web any required tension, and to conduct it in the proper direction. But for the more convenient application of these guide wheels to other parts of the web and felting where the ruler bars are not used, we construct the frame or carriage differently; and instead of the forked end, as at I I, we make them with a round pin, as at A A in the drawing No. 2, Fig. 2, wherein B is an iron socket, into which the pin is inserted and held in any required position by the screw C, and by making the piece of iron with the socket of an appropriate shape, the same may be conveniently applied to any part of the frame, as is done at A A and B B, &c. See the general drawing No. 1.

We shall now continue our description of the remaining parts of the machine delineated in the drawing No. 1. At B h, B h, &c. are placed small rollers for the purpose of supporting the under part of the revolving under web

web as it returns from E to C. *Bi* is a section of a shallow trough which we place underneath the web, and of a width equal thereto, in order to receive the water which drains from the pulp after it falls upon the web at C, and to conduct it by a spout at any one side to any convenient receptacle, as at *Bk*, from which it is again raised, and returned into the vat by means of the tubes or scoops *Bl*, placed round the axis *Bm*, and revolving thereon, their extremities at the same time dipping into the receptacle at *Bk*, from whence the water is to be raised, and is by them lifted and discharged at their other ends or orifices at *Bn*, and conducted to the vat. As the construction of the tubes is sufficiently evident from the drawing, we need not enter into further particulars. We would only observe, that our reason for preferring the method above described to the more obvious one of a pump is, to prevent as much as possible the paper stuff or pulp which drains off in the water from being formed into small lumps or rolls by the mutual friction or rubbing of any parts of the apparatus against each other; and our reason for returning the water into the vat is, that we may prevent the waste or loss of a considerable portion of the paper stuff, blue size, &c. which would otherwise be sustained by its running to waste.

The effect produced by shaking the mould upon which the paper is commonly made is so well understood by every paper manufacturer, that we need not here either explain the intention with which it is done, or the necessity of doing it, but proceed to describe how we perform that operation by the machine. It will appear by considering the construction of the shaking bar, and its connection with the ruler bars and upright supports *uu*, that

it is capable of being moved backward and forward in a horizontal direction (or nearly so), and carrying with it the roller C and ruler bars *yy*, which admit of an angular motion in the joints at each end: and that whatever motion may be given to these the same will be communicated to the web upon which the paper is forming, and is here a substitute for the moulds used in the common process. And we do, by means of a crank communicating with the shaking bar *t*, cause it to receive a quick alternating or vibratory motion; or, in other words, we cause it to shake in the direction above described. The number of these vibrations or shakes necessary in a given time, and the space passed through by the shaking bar in each, will vary according to the quality and preparation of the pulp or paper stuff of which the paper is intended to be made. The number, however, seems by observation to be limited between one and two hundred *per* minute, and the space between one quarter of an inch and one inch; and, to enable us to give a proper velocity to the crank, we give motion to the same by a small water wheel, the velocity of which, and consequent number of vibrations, are regulated at pleasure by the quantity of water admitted upon the wheel.

And we do further and more particularly describe that part of our said machine which we call the second or dry press with the cylinders and other apparatus connected therewith as follows; that is to say, N and O are two strong brass cylinders with iron shafts or spindles *B o* and *B o* firmly fixed therein. *B p* and *B p* are the iron carriages and bearing brasses, in which the said spindles turn, and by which the same are held in their proper position; *B q* and *B q* are the compressing screws; P is the couch-
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ing roller with its pivots resting upon and turning in the ends of the two levers *B r* and *B r*, which project from and are fastened in the spindle or bar *B s*, placed across the machine frame with its ends projecting on each side thereof, upon which are fastened the handles *B t* and *B t*, by which the roller may be raised or lowered for the purpose herein after mentioned. The brasses or bearings upon which the spindle *B s* turns at *B u* and *B u* are affixed to the iron carriages or sliding pieces *m* and *m*, so that as the roller *E* may be moved backward or forward, the couching roller *P* may retain its relative position therewith. We have already observed that the endless or circulating flannel or felting passes between and receives its motion from the pressing cylinders *N* and *O*, and that it revolves upon and is kept extended by the two extreme rollers *P* and *Q*, and that the darts or arrows indicate the direction in which it moves. We have likewise shewn the means of extending the same longitudinally by the stretching screws *p* and *p*; *B v* are wooden rollers for conducting the felting in the direction delineated in the section; *B w* are ruler bars with guide wheels affixed thereto for extending the felting laterally as above described. We cause the felting on its approach to the cylinders to have about the same inclination downwards as we give to the revolving wire under the same circumstances and for the same reasons; and we cause the paper upon the felting to pass between the cylinders immediately in contact with the smooth surface of the upper cylinder *N*; and in order to detach the paper from the cylinder, to which it closely adheres after receiving the pressure, we cause a thin steel plate to be fastened to a piece of wood as at *B x*, having its edge previously sharpened, and applied along the surface of the cylinder

in such a direction as to separate the paper therefrom until it can be drawn away by hand and deposited upon the felting, by which it is conducted to the reel at R, to which it is fastened, and by it drawn from the cylinder with such a degree of force as to prevent it coming again in contact with the steel plate which it ought only to do at the beginning of each sheet; R is a reel upon which the paper is collected at the end of the machine, the construction and use of which is evident from the drawing. B z is a band wheel affixed to the spindle or shaft of the under cylinder O, and gives motion to another at C a, the spindle of which stands opposite to and concentric with the reel spindle, and from which the reel receives its motion; the means of connection being such, that the reel may be put in motion, stopped, removed and replaced at pleasure, and is performed by any of the well-known methods of continuing motion from one shaft or spindle to another, when in the same line with each other. C b are two pinions, one on each of the cylinder shafts or spindles, with their teeth taking in each other, in order that the cylinders may move uniformly with each other, without sliding or slipping. C c are likewise two pinions upon the spindles of the wet press cylinders.

The operation of detaching the paper from the revolving web, and depositing it upon the felt, is performed by means of the couching roller P, which is placed immediately below and exactly parallel with the roller E. When the paper formed upon the wire arrives at the roller E, the couching roller is raised by the handles B t B t, and causes the felting to rub against the web, and to detach the paper therefrom, and immediately to deposit it upon the felt. The couching roller is then lowered, as the paper being once deposited in a sufficient quantity upon

upon the felt, its own weight will continue to draw it from the web whilst the felting is in motion.

Having thus more particularly described the conformation of the principal parts of our machine, we do further describe the manner in which we give motion to the same, and the connection between them and the first mover: That is to say, we do employ water or more immediately a water wheel, as a first mover, which we prefer to any other power, as by it is obtained the most regular and uniform motion, and such as is best adapted for this purpose, though other first movers might be used.

C d is the axis of the water wheel (the wheel itself, being of the common construction, is supposed, and not represented in the drawing), upon which is fixed or hung the wheel *C e*, the teeth of which take into those of *C f*, another wheel hung upon the spindle *C g* lying opposite to or in a line with the shaft or spindle of the under cylinder *B a*. *C h* is a coupling or clutch box, for the purpose of giving motion to or stopping the cylinder as may be required, by any of the well-known methods in common use for such purposes.

C i is a wheel likewise working into or taking its motion from *C e*, having upon its axis the rigger or band wheel *C j*, which by means of a strap or band communicates motion to another band wheel *C k* hung upon the spindle *C l*, lying opposite to or in a line with the spindle or under wet press cylinder *X*. A coupling or clutch box is placed upon its end at *C m*, for the same purpose as the one upon the spindle *C g* above described. And we do cause the rigger or band wheel *C j* to be made upon an adjustable principle, or capable of having its diameter increased or diminished as occasion requires, whilst the machine is at work, and by this adjustment obtaining an

exact

exact correspondence between the velocity of the revolving web and that of the revolving felting; for, should one exceed the other, the paper would either be torn asunder or carried round upon the under side of the web, and be spoiled.

Fig. 3. In No. 2 of the drawings hereto annexed (see Plate X.) is a plan and section of the adjustable or expanding rigger or band wheel. AA is a cast iron flanch or plate hung upon the spindle BB. CC are two rings cast upon the face of the flanch. The intermediate space between the rings is turned flat and true, so that its plane may be at right angles with the axis or spindle upon which it turns. DD, &c. are round pins inserted and made fast in the rings at a proper distance from and parallel with the face of the flanch, forming so many radii or parts of radii at equal distances round the flanch; and upon these radii or pins we cause the pieces EE, &c. to slide, the pins passing through the holes at each end of the pieces at F and G corresponding to the diameter of the pins; one end of each piece, as at HH, is made to extend on each side of the pins, and fitted to the face of the flanch so as to prevent the pieces EE, &c. from turning or tilting sideways upon the pins, but nevertheless allowing them to slide freely upon the flanch. II, &c. are wooden segments forming the periphery of the wheel, and fastened upon the sliding pieces EE, &c. K is a straight round pin inserted in a hole in the centre of the spindle and in which it is at liberty to slide in and out. LL is a round plate fastened upon the centre pin K, and the connecting pieces MM, &c. have one of their ends attached to the edge of the plate L by means of a joint, the other to the sliding pieces EE, &c. in the same manner;

manner ; so that whenever the centre pin is pushed in, and the plate brought nearer to the flanch, the sliding pieces and segments I I will uniformly expand, and the diameter of the wheel be increased ; or, on the contrary, if the pin is drawn out, the diameter will be decreased. The pin is pushed in, drawn out, or held in any required position by the screw N N, by which the rigger may be regulated whilst in motion.

In the general drawing No. 1 is represented likewise the machinery for communicating motion to the hogs or agitators T T, &c. The long spindle C n is put in motion by the pinions and wheel C o C o C o ; upon the other end of the spindle C n is hung a cast iron flanch C p, with one of its sides made flat and straight across, against which the edge of the wheel C q is held with such a degree of pressure as that the friction between the flanch and the edge of the wheel C q may be sufficient to cause the wheel C q to revolve and give motion to the agitators. The wheel C q is made to shift upon the spindle C r, and capable of having its edge opposed to the face of the flanch at any intermediate distance between its centre and circumference, for the purpose of adjusting the velocity of the agitators to the velocity of the machine, which varies with the quality and thickness of the paper made thereby.

We likewise give motion to the lifting tubes B l from the spindle C r by means of the two riggers or band wheels C s and C t.

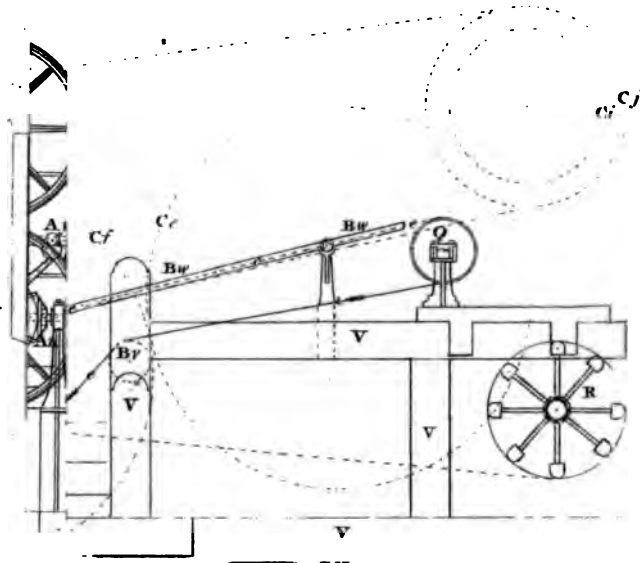
In some situations where a water wheel cannot be conveniently applied to give motion to the shaking bar t, we connect it with the spindle C n, and regulate its velocity by two friction wheels similar to those at C p and C q.

We

We now proceed to describe the means used for subdividing or cutting the long sheets of paper made by our said machine into others or smaller ones of the required dimensions; that is to say, we construct a wooden frame or table of a convenient height, its length is determined by the dimensions of the sheets of paper into which the long sheets upon the reels or rollers are to be subdivided or cut, and its width is made somewhat more than the widest sheet which can be made by the machine by which the paper was formed. The reel or roller containing the paper intended to be cut is placed immediately above one end of the said table at right angles with its longer sides, and parallel with the top or upper surface thereof. The pivots or axis of the reel or roller are supported and allowed to turn in two wooden posts affixed to the ends of the table for that purpose, so that two workmen, one on each side of the said table, by laying hold of the corners of the sheet may draw it from the reel and spread it upon the table preparatory to its being cut or subdivided into smaller ones.

Near that end of the table over which the reel or roller is suspended, and parallel with the reel, we place two long hardened steel plates about three inches in width, and about one-eighth or one-tenth of an inch thick, and their length ought to exceed the width of the widest paper to be cut about thirty inches.

These steel plates we affix to two strong iron bars by means of screws or clamps, one steel plate upon each bar; and place them in such a position across the table that the upper edges of the steel plates may be parallel with and about one twentieth of an inch from each other, and in the same plane with the upper surface of the table upon which the paper is to be spread. The under
or



or lower edges of the steel plates are extended to a considerable distance from each other, so that a vertical section of the plates, or a section made at right angles with their edges, would form two sides of an equilateral triangle nearly, or their relative position would somewhat resemble the outer strokes or legs of the letter A. And we cause the upper edges of the said steel plates to be ground so that the basils formed by grinding the edges of the said steel plates may be in a line with each other, or in the same plane with the surface of the table or nearly so, and that the inside or opposed edges of the two plates may be sharp. We likewise construct one or more hardened steel wheel or wheels about three inches diameter, turned true, with a sharp edge round the same, basiled away on both sides similar to the edge of a hard or cold chissel commonly used for cutting iron when cold; and in each wheel we affix a transverse axis or arbor, upon which they may revolve. The edges of these wheels being applied between the opposed edges of the hardened steel plates, and the wheel or wheels caused to revolve upon them from one end to the other, the paper having been previously spread upon the table and over the edges of the said steel plates; and the said steel wheel or wheels being held down by a sufficient weight, the paper is cut by their action against the sharpened edges of the steel plates, as they revolve upon such steel plates. And to facilitate the operation, and render it more expeditious, we cause two other hardened steel plates, similar to those above described, to be placed across the table in a similar position, and further from that end of the table over which the reel is suspended, and exactly parallel with the former ones, and at such a distance from them as corresponds to the dimensions of the sheets of paper to be cut, from the larger

or longer one upon the reel or roller; and by applying two of the above described hardened steel wheels at a convenient distance from each other, upon the edges of one pair of the steel plates, and one other of such wheels upon the edges of the other pair of steel plates, and by connecting the said three wheels firmly together by means of proper frame-work, in which the arbors or axes of the said wheels turn, and whereby the wheels themselves are held in a proper position, and their edges falling into the space between the edges of each pair of steel plates respectively, we obtain a carriage with three wheels, capable of supporting itself upon those wheels, two on one side and one upon the other; and upon the said carriage we place a box containing a weight, or a number of weights, sufficient to produce the effect above described, *viz.* occasioning such a resistance between the hardened steel wheels and the edges of the steel plates, as to separate or cut the paper placed between them. The iron bars supporting the second pair of steel plates or those furthest from the reel, are so affixed to the frame of the table, that they may be moved nearer to or further from the other pair of steel plates, and again set parallel therewith; and likewise the frame-work to which the steel wheels are affixed is so constructed, that the distance between the one wheel on one side, and the two other wheels on the opposite side, may be made equal to the distance between the edges of the two pair of steel plates, according to the intended dimensions of the sheets of paper required.

Having as above described and ascertained the application and use of the instruments, as well as the instruments themselves which we now use for cutting or subdividing

dividing the paper, so as to render it perfectly intelligible to a mechanist; we need not here enter more particularly into any further description in relation to the construction or conformation of the said instruments; but, for the better understanding their application, we do further describe the operation of cutting or subdividing the sheets of paper, as the same is performed by us; that is to say: we cause the table and instruments above described, to be placed at or near the end of the machine by which the paper is made, and as soon as one of the reels or rollers becomes charged or filled with paper, we remove the said reel or roller from the machine, and place it upon the supports or posts affixed to the end of the cutting table, upon which the steel plates and wheels have been previously adjusted to their proper distances, &c. Two workmen, one stationed on each side of the table, draw the paper from the reel and spread it upon the said table, depositing the first end of the paper, which is always rough and uneven, over or beyond the pair of steel plates furthest from the reel, taking care at the same time to lay the edges of the paper parallel with the edge of the table, or rather at right angles with the edges of the steel plates, in order that the angles or corners of the sheets of paper, when cut, may be square; and these workmen are guided or directed in this operation, by having several conspicuous lines drawn along the table in the proper direction, parallel to which lines they lay the edges of the sheet. The paper being thus deposited or spread uniformly upon the table and over the edges of the steel plates, the man on whose side the carriage with the three cutting wheels stands, pushes it across the table to the man on the opposite side, where it is retained ready for a se-

Patent for making Carbonate of Lead,

cond:operation. By thus passing the wheels over for the first time, the rough or uneven end of the sheet is separated at the plates farthest from the reel, another separation being made at the same time by the plates nearest to the reel, leaving one whole sheet of paper between the two pair of steel plates. The paper is again drawn from the reel and spread upon the table, and the end of the sheet being now square and even, is laid so much over or beyond the edges of the steel plates furthest from the reel, as will leave a sheet of paper when the next separation or cutting is made. Two sheets being now separated by each cutting after the first, the wheels are again passed over, and the sheets thus separated at each cutting are removed, and laid into packs by children employed for that purpose.

In witness whereof, &c.

Specification of the Patent granted to EDWARD MOORE NOBLE, of Birmingham, in the County of Warwick, Surgeon; for a new Method of making Carbonate of Lead; commonly called White Lead.

Dated January 23, 1808:

TO all to whom these presents shall come, &c. NOW KNOW YE, that I the said Edward Moore Noble, in compliance with and in performance of the aforesaid proviso in the said in part recited letters patent contained, do by this present instrument in writing declare, that the nature of my said invention and the manner in which I perform the same is as follows: I take lead; which I prefer to be in thin plates or small pieces, and place it in a vessel that has a small communication with the atmosphere: to this I add so much acetic acid or
I fre-

vinegar, or a solution of acetite of lead, or of both, that the lead may not be wholly but only partly immersed in the liquor. I then transfer into the vessel a mixture of carbonic acid gas and oxygen gas, or of carbonic acid gas and atmospheric air, or a mixture of all three; and I frequently agitate the mixture in order to make the liquor pass over and act upon the lead, and that the carbonate of lead when formed may be removed from the surface of the metal, and a fresh surface thereof may be exposed. Or instead of lead in a metallic state, I take litharge or an oxyd of lead, containing the proportion of oxygen that will enable it to unite with acetic acid; and to this I add either acetic acid or a solution of acetite of lead, or both acetic acid and acetite of lead, taking care that the quantity of oxyd of lead be at least sufficient to saturate the acid. I then transmit into, through or upon the mixture, carbonic acid gas, either in a state of purity or mixed with atmospheric air with oxygen gas, or with any other gas that will not injure the process; and I find it expedient frequently to agitate the mixture to facilitate the union of the carbonic acid with the oxyd of lead. Whichever process I make use of, a white substance is produced, which is the carbonate of lead, commonly called white lead or ceruse; but the degree of whiteness will depend upon the quality of the materials employed, upon the operation being well or imperfectly performed, and upon its being more or less free from mixture with other substances. When the carbonate of lead is formed, I separate it from the mixture; and if I intend it to be mixed with oil, I dry it: I sometimes find it expedient to wash the carbonate of lead with water previously to its being dried. In witness whereof, &c.

Specification

*Specification of the Patent granted to SAMUEL PHELPS, of
Cuper's Bridge, Lambeth, in the County of Surrey,
Esquire; for certain Improvements in manufacturing
Soap. Dated January 23, 1808.*

TO all to whom these presents shall come, &c.
NOW KNOW YE, that in compliance with the said pro-
viso, I the said Samuel Phelps do hereby declare, that
the nature of my said invention and the manner in which
the same is to be performed are particularly described
and ascertained as follows; that is to say: Instead of
constructing and using a vessel of the usual materials,
form and dimensions, for boiling and making soap, com-
monly called a soap copper, with a fire-place beneath
the same, I do construct and use a boiler or vessel of
any materials whatever, which are or may be proper to
contain the component parts of soap during the process
of boiling the same, and of much more considerable
dimensions, if required, than the common boilers or
soap coppers. And that instead of raising the temper-
ature of the goods, namely, the lees, and the fat or
oily component part of the soap, to the boiling heat, by
the application of fire alone, as hath hitherto been done,
I do introduce steam through one or more pipes or
passages into the said goods; and I do avail myself of
the usual means of obtaining the said steam, and of in-
troducing the same at such temperature as may be re-
quired at or above the common boiling water point, by
subjecting the same, if needful, to pressure or re-action.
And that in general I find that the re-action or pres-
sure afforded, by suffering the said steam to pass into
the said goods at the depth of about four feet below the
surface,

surface, is sufficient to cause the same to boil very speedily, and to produce a very perfect combination or union of the component parts throughout, in much less time, and with a less expenditure of lees than in the ordinary process of making soap. And that in preference, I suffer the steam to escape into the goods at a distance not exceeding one foot from the bottom of the said boiler or vessel. And further, that I do prevent any introduction or rising of the goods from the boiler or vessel, or soap copper, into the steam boiler (at such times as the varying efficacy of the fire beneath the said steam boiler might otherwise allow that effect to take place), by interposing a cock or cocks, valve or valves, or other similar well-known contrivances in the pipes, passages or communications, between the said steam boiler and the said other boiler, copper or vessel, in which the soap is to be made. And I do further declare, that it is not requisite as to my said improvements, that the said pipes, passages or communications for the steam, should be made of any precise dimensions or proportional magnitude. And that in practice, upon a scale of considerable magnitude, I find that one pipe having its aperture one inch in diameter, does effectually answer the intended purpose. And further, that whereas, by the introduction of steam as aforesaid, the strength of the lees or the relative proportion of water to the alkaline salt therein contained, is in some measure altered by the condensation of the said steam, or part thereof, I do make an allowance for the same by using an additional quantity of lees of such greater strength, at the first or any subsequent supply, as may be needful or advantageous.

And

And lastly, that as to my steam-boilers and the furnaces thereunto and therewith to be adapted and used, I do adopt and use the best means of constructing and working the same in my said improvements, according to the methods adopted and used in steam engines, and other works wherein a supply of steam is or may be required. In witness whereof, &c.

Specification of the Patent granted to WILLIAM HAWKES, of Newport, in the County of Salop, Esquire; for Improvements on musical-keyed Instruments of twelve fixed Tones. Dated July 25, 1808.

TO all to whom these presents shall come, &c. NOW KNOW YE, that in compliance with the said proviso in the said letters patent contained, I the said William Hawkes do hereby declare, that my said improvements on musical-keyed instruments of twelve fixed tones are described as follows; that is to say: The improvements in the organ is effected by a pedal under the key-board, and an extra slide to every stop in the sound-board to correspond with the general slide. The above extra slide has a communication from the sound-board to the extra pipes, namely, sharps and flats; which by depressing the pedal with the foot brings on the sharp scale, and by elevating the pedal brings on the flat scale; and as the flats go off the sharps are brought on, and inversely as the sharps go off the flats are brought on, by the action of the pedal communicated to the additional slide with double holes adapted to the additional pipes, namely, five pipes to each octave.

My

My improvement in the piano forte is effected by adding seven diatonic and five flat tones to our present scale of twelve fixed tones, which form two chromatic scales; the one termed a flat scale and the other a sharp scale, and is done by two sets of strings, of two unisons to each set, which are acted upon, without the addition of a key to the key-board, by a pedal, by which the key-board is made to move forward and backward about one-fourth of an inch, the same hammers striking each set of strings both in the flat and sharp scale, by depressing the pedal with the foot when the sharp scale is wanted, and elevating the pedal when the flat scale is wanted.

In witness whereof, &c.

Account of the third Voyage of the Ship Economy, built according to Mr. J. W. BOSWELL'S Patent Plan.

Communicated by the Patentee in a Letter to the Editors.

GENTLEMEN,

I REQUEST you will be so good as to insert the inclosed letter from Captain Ross, relative to the performance (on her third voyage) of the ship Economy, built according to my invention for constructing large ships of small timber so as to be stronger than those built in the common method, which method is described in the fourth volume of the present series of your work.

I have the satisfaction to find that the excellent performance of the ship, in the several voyages she has made to the West-Indies, in the very trying weather she frequently met with, has fully justified my ideas of the strength of the plan.

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It

It must be evident to every thinking man that the mode of building, that has stood so well in a ship of 200 tons, must be perfectly adequate for those of a larger size; and that the experiment is now tried sufficiently to satisfy the most circumspect; and a very short calculation must suffice to show the saving that must arise from building with timber of half the usual price for most of the frame; as would be the case with ships built on my plan above 500 tons burthen.

For vessels of this last size I would lay the decks, on a plan, within the limits of my patent, which has been shown to Sir William Rule above a year since; and of which, with some other matters relative to the ship, I intended to have sent you an account before this, but have been prevented by more urgent business.

I have examined the internal frame-work of the ship, and find it perfectly firm in all its joints; the sheathing I also found in an excellent state, without any appearance of being touched by the worm; which I attribute to the cause mentioned by Captain Ross. On her first voyage her sheathing was painted with white lead, which is reckoned to resist the worms well; nevertheless the sheathing was much cut by them, which was partly owing to her long detention in the West-Indies by the French fleet. On her second voyage she had what is called a brimstone bottom, in which voyage the sheathing was likewise much cut. On the last voyage she has had a new sheathing managed as Captain Ross describes, and returned with it in the state mentioned; which certainly is much in favour of the use of coal tar.

I take this opportunity to beg leave to notice a strange assertion (made in a treatise on finding the longitude, published about two months since by a French Count),
relative

relative to my invention for ascertaining the rate of a ship's way, of which an account was inserted above a year ago in the sixty-first number of your Repertory. Although my paper on the subject was published near a year before the Count's treatise appeared, he *modestly* accuses me of *borrowing* the plan from him, through the medium of a certain noble Lord, or the Lords of the Admiralty, who, he says, betrayed his secret to me.

It is not worth while to say much in refutation of charges so palpably absurd; I shall therefore merely state two or three facts, for which I stake my veracity. First, I never heard of the existence of the Count, or that he or any one else had laid claim to the invention, before the end of May in the present year, when, to my great surprise, the above circumstances were told me. Secondly, I never saw to my knowledge the nobleman mentioned by the Count, nor had I ever any communication directly or indirectly with him, or with any of the Lords of the Admiralty, on the subject; nor did I ever receive the slightest hint of the invention from any one else. Thirdly, I had no interest whatever to serve by publishing my invention, but the pleasure of hoping to benefit the sea-service.

Every one who has had business to do at the Admiralty will smile at a charge implying a degree of accessibility on the part of their lordships, which no one yet has had the happiness to experience. For my part, my interest with them has never been sufficient to procure even the slight favour of a copy of the Report of the Navy-board on the ship Economy, and the plan on which she is built, which I think, in justice to me and to the public, should have been granted, and for which I very earnestly solicited.

On this occasion the Count must be content if he can free himself from the appearance of plagiarism with regard to my paper published so long before his treatise ; for this is not a country, where the bare assertion of any man, incapable of proof, can bias the opinion of the public.

Yours, &c.

JOHN WHITLEY BOSWELL.

Extract of a Letter from Captain Ross to Mr. Boswell.

Dear Sir,

London, Aug. 11, 1608.

I feel much pleasure in stating to you some particulars of my second voyage to Demerara in the *Economy*, built according to your patent. We sailed from Portsmouth the 18th of December last, under convoy of the *Astrea* frigate, and on the 25th the wind shifted to the S. W. and continued Westerly until the 6th of January ; during which period we experienced several heavy gales, which dispersed the fleet, and several ships bore away for the ports in the Channel, with damage. But although the *Economy* was deep laden, having nearly a full cargo, with a large proportion of bricks and ballast, she made astonishing good weather, and shipped only one sea, which broke the spanker boom in three pieces as it lay lashed to the gangway stantions, which may give you some idea of the force of sea at the time. After the gale abated, we saw only about forty sail with the frigate, with which we proceeded, and delivered our cargo at Demerara without the least appearance of damage ; and I have never been in any ship that I had so good an opinion of in point of strength. On looking over the log-book on the homeward passage, I see that almost every
day

day we either shortened sail or hove to for the ships astern. Our cargo home was chiefly coffee in bags; for which she is extremely well adapted, and which was delivered at No. 5, in the West India Dock, in the best order possible. She is now in dock to get a clean bottom, and in such good order that she is fit for any voyage without the least repair, not even caulking. The sheathing is perfectly free from the worms, which may be owing to her having been paid with coal tar in the following manner; *viz.* The seams of the bottom were carefully caulked and paid with common pitch, and then the bottoms paid with coal tar. The sheathing paper was *very thick*, and dipped in coal tar, and the sheathing put on *without hair*; the seams of the sheathing caulked and paid with common pitch; and then a good coat of coal tar over all. I am, dear Sir,

Your most obedient servant,

Mr. Boswell.

WILLIAM ROSS.

*An Account of Captain COWAN's improved Sails for Ships
and Vessels of all Descriptions.*

Communicated by the Patentee in a Letter to the Editors.

GENTLEMEN,

AS I find you have inserted in your ninth volume of the present series the specification of my patent for improvements on ships sails, I request that you will do me the favour to admit likewise the reports sent herewith, in order to convince such of your readers as may be interested in the preservation of ships and men's lives, how fully and satisfactorily the plan has answered.

I am

I am rather apprehensive that the introduction of such papers in your work may not be precisely within its plan ; but when it is considered to what dreadful dangers ships and vessels are now unnecessarily exposed from the old mode of sail-making, and how many are naturally interested in the continuation of the errors, absurdities, and abuses that prevail in the present mode of constructing and equipping of ships, however dangerous and destructive they may be, I trust you will permit their insertion. I think that the advantages derived to shipping from my plan, will appear more evident and convincing to such of your readers as have opposite interests, from the documents themselves, than from any description that could be given.

It will appear from the reports, that every ship in His Majesty's navy and merchant service, independent of other causes, are now exposed unnecessarily to the greatest danger when on a lee shore, from the following accidents to which the old sails are liable. They cannot be reefed without hauling up ; by which, they lose their effect on the ship whilst reefing, during which time she drives to leeward. They are liable to split in hauling up and setting, particularly if half worn ; and half worn sails often require reefing to save them.

Ships are often lost on a lee shore from splitting the sails. Sails with vertical seams will blow to pieces in a gale of wind if a few inches of a seam give way ; but with the horizontal seams, the strain is taken off the seams, and the sail is strengthened most in the direction of the greatest strain.

The preservation of a ship on a lee shore in squally weather may depend on carrying a press of sail, and on the sails standing the gale : now, to prove to the scientific

the and unprejudiced part of the community that the sails of ships can be made infinitely stronger, more durable and more effective, for the safety of shipping, is my motive for requesting the favour of you to allow a place in your work for the reports.

I am, Gentlemen, yours, &c.

MALCOLM COWAN.

Official Report on Capt. M. Cowan's Sails,

Extract from Capt. Shephard's Report to the Admiralty.

Sir, H. M. Ship *Thisbe*, Guernsey Roads, March 13, 1805.

I beg you will acquaint my Lords Commissioners of the Admiralty that I had an opportunity of trying a main course on Captain M. Cowan's plan on the 12th ult. in a very strong gale of wind from the E. S. E.

I had occasion to reef the courses, and the main one was reefed in two minutes, without a man going aloft, and with very few hands. The sail remained perfectly quiet during the gale, without the least fret or chafing.

It has many advantages over the former construction; not only for expedition, but when weakly manned, particularly on a lee shore, when it would not be prudent to start either tack or sheet; and the reef can as expeditiously be let out should there be occasion to chase.

I find the sail to haul up far more snug than the old way, and, in my humble opinion, I cannot find one objection against it; and every seaman must feel himself very much indebted to Captain Cowan for his most excellent plan. I have the honour, &c.

(Signed)

LEWIS SHEPHEARD,

William Marsden, Esq. Secretary
to the Admiralty, &c. &c.

Thisbe, 28 guns.

Copy

Copy of a Certificate from Capt. J. Sykes, of the Nautilus.

London, May 22, 1865.

I hereby certify, that his Majesty's sloop *Nautilus*, late under my command, was supplied with a set of the courses on the plan of Captain M. Cowan, and that having tried them in bad weather I much approve of them for many superior advantages over the old sails; and consider it an invention of extraordinary benefit to the sea service in general, particularly to merchant vessels, as tending immediately to their preservation on a lee shore.

They can be reefed while set on the ship without lessening any other part of the effect of the sails, and in a simple manner by few hands, and the reef let out again with great expedition in the worst weather.

They are also less liable to split in taking in and setting.

(Signed)

J. SYKES.

N. B. These sails met general approbation on board the *Nautilus*.

Nautilus, 18 guns.

*Extract of a Letter from Captain Sheppard to Captain
M. Cowan, R. N.*

Sir,

London, May 23, 1866.

Having tried your course in his Majesty's sloop *Su-
rinam* under my command during the winter, when we
had almost incessant gales of wind, and in the Bay of
Biscay, when it became necessary to reef without other-
wise shortening sail; I beg to assure you that we found
it answer every end you propose; and I have no doubt,
when better known, it will be generally adopted.

(Signed)

ALEX. SHEPPARD.

Extract

*Extract of a Letter from Captain J. Stuart, R. N. to
Captain M. Cowan.*

London, July 10, 1806.

Sir,

Being First Lieutenant of His Majesty's ship *Minotaur*, I had frequent opportunities of trying your reef, which answered beyond expectation, having repeatedly taken in the reef, and let it out three or four times a day, which was done in a few minutes, without taking the sail off the ship.

But it was particularly of service to us after the action off Trafalgar, while carrying sail off the lee shore, and here we found the greatest benefit, in being able to take the reef in during the heavy squalls, and let it out again so expeditiously when it moderated.

(Signed)

J. STUART.

Minotaur, 74 guns.

*Extract of a Letter from Mr. Edward Harper, Ship
Owner, to Captain M. Cowan.*

Hull, November 2, 1807.

Dear Sir,

I think it but justice to give you a further account concerning your most valuable improvements in reefing sails at the foot, and making them with the cloths horizontal.

With respect to your courses that reef without starting tack or sheet, the ship *Cognac Packet* has had one in use above two years; and from every account I hear, that very easy, expeditious, and safe plan of reefing, cannot fail of being generally adopted ere long.

Respecting the horizontal cloths, I had a new main top-sail and main stay-sail made for her on that plan a

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year

258 *Account of Captain Cowan's improved Sails.*

year ago at Liverpool, and have examined them after the many extreme hard gales they have stood, and I find them much less chafed, &c. in proportion than any sails in her on the old plan.

So perfectly convinced am I of the superior saving and safety of your mode of reefing, and making with horizontal cloths, that I have had a fore-sail on that plan made here, and I shall in every ship I am concerned in, not fail having my sails made on your plan.

I suspect few men who have experienced a severe gale of wind on a lee-shore, will for a moment hesitate in believing your mode of reefing, without starting tack or sheet, and strengthening the sails by making them with horizontal cloths, will be the means of saving lives and property.

(Signed)

EDWARD HARPER.

*Extract of a Letter from Captain Hornby, of the Birna,
of Grimsby, to Mr. W. Gibson, Sail-maker of Hull.*

December 1, 1806.

I approve of Captain Cowan's sails very much: the experience I had of them during our voyage to Davis's Straits, convinced me they answered every purpose set forth in the directions; and as long as I am enabled I shall not go to sea without them.

I am well aware there are men in most professions wedded to old customs and opinions, and vain would it be to point out to them their utility; but to me, the satisfaction I experienced in reefing courses without starting tack or sheet, or shaking the sail, will never be effaced from my memory: and let those seamen who
were

were never on a lee shore, or in a narrow passage, in a ship badly manned in a gale of wind, reflect that they are still liable to such cases, and then disapprove of it if they can.

These sails do not shake in hauling up to reef, therefore must last longer.

(Signed)

FRANCIS HORNBY.

Description of an Improvement on Tide-Mills, to make them work as well at high and low Water as any other Time of Tide. By Mr. JOHN ISAAC HAWKINS.

Communicated by him in a Letter to the Editors.

GENTLEMEN,

I HEREWITH send you an account of another of the improvements exhibited in my Museum of Useful and Mechanical Inventions.

The improvement consists in having a reservoir to be filled by the tide at high water, through a canal furnished with a valve sluice, so as to let the water pass into the reservoir, but not to go back again the same way. The content of this reservoir or upper pond is to be conveyed by the usual means over or under a water wheel, and then received by another reservoir or lower pond, where it is retained till the time of low water, when it opens another valve-sluice, and discharges itself into the river or sea from whence it was received.

Upon this principle a constant fall of water from the upper into the lower pond is obtained by means of the rising and falling of the tide, and that without requiring any person to attend it; for whenever the water is higher

in the river or sea than in the upper pond it will open the sluice and fill the pond; and whenever it is lower in the river or sea than in the lower pond, the weight of water in the latter will open the lower sluice.

The manner of making valve-sluices must be too well known to need description, since they are used on the low lands on the banks of most tide waters.

There are many situations on which this plan may be adopted with little expense: in places where the general level of the land is about half way between high and low water, nothing more would be necessary than to dig out the lower pond, and with the same earth make an embankment, which will form the upper.

The size of the ponds must of course depend on the degree of power wanted: if each will hold water enough to turn the wheel about ten hours, they will be sufficiently large, since the upper pond will be full at high water, and replenished again soon after the middle of the rising tide; and the lower pond will be empty at low water, and begin to be emptied again immediately after the middle of the falling tide.

The principle of this improvement may be added to those tide-mills already in use that work forwards and backwards.

Let two small ponds, an upper and a lower, be dug, each capable of holding water enough for turning the mill about two hours: these may be called auxiliary ponds, and the original one the main pond.

Let there be two channels for the water to go into the main pond, one under the water-wheel, and the other merely to fill the pond; and let there be a communication from the water-wheel channel to each of the auxiliary ponds, and also from these to the river or sea.

Then

Then might the motion of the water-wheel be always kept up with full force; for during the rising of the tide, and until within about an hour of high water, the current would be under the water-wheel and into the main pond as usual; but the force of the tide then slackening, the communication between the water-wheel channel and the main pond must be shut, and the current after passing the wheel be turned into the lower auxiliary; at the same time the tide must be admitted into the main pond through the other channel, and the upper auxiliary also filled.

By the time the lower pond is full, the tide will be running down strong enough to admit of the wheel being turned backwards, in the ordinary way, by the contents of the main pond passing back through the water-wheel channel. This will continue until about an hour before low water, when the contents of the upper auxiliary pond must be carried under the wheel, and then discharged into the river or sea, and the main and lower auxiliary ponds allowed to empty themselves.

Thus might all the advantages of the double-pond system be added to the tide-mills now in use with but little expense. They would, however, require more attention than if the mills were entirely upon that system, since it would be necessary to turn the water from one channel into another; whereas in the other case, the sluice-valves would be always worked by the pressure of the water.

I am, Gentlemen,

Yours, &c.

JOHN ISAAC HAWKINS.

An Account of the Application of the Gas from Coal to economical Purposes. By Mr. WILLIAM MURDOCH.

*Communicated by the Right Hon. Sir JOSEPH BANKS,
Bart. K. B. P. R. S.*

From the PHILOSOPHICAL TRANSACTIONS of the ROYAL
SOCIETY of LONDON.

THE facts and results intended to be communicated in this paper are founded upon observations made, during the present winter, at the cotton manufactory of Messrs. Philips and Lee at Manchester, where the light obtained by the combustion of the gas from coal is used upon a very large scale; the apparatus for its production and application having been prepared by me at the works of Messrs. Boulton, Watt, and Co. at Soho.

The whole of the rooms of this cotton mill, which is, I believe, the most extensive in the United Kingdom, as well as its counting-houses and store-rooms, and the adjacent dwelling-house of Mr. Lee, are lighted with the gas from coal. The total quantity of light used during the hours of burning, has been ascertained, by a comparison of shadows, to be about equal to the light which 2500 mould candles of six in the pound would give; each of the candles, with which the comparison was made, consuming at the rate of 4-10ths of an ounce (175 grains) of tallow *per* hour.

The quantity of light is necessarily liable to some variation, from the difficulty of adjusting all the flames, so as to be perfectly equal at all times; but the admirable precision and exactness with which the business of
this

this mill is conducted, afforded as excellent an opportunity of making the comparative trials I had in view, as is perhaps likely to be ever obtained in general practice. And the experiments being made upon so large a scale, and for a considerable period of time, may, I think, be assumed as a sufficiently accurate standard for determining the advantages to be expected from the use of the gas lights under favourable circumstances.

It is not my intention, in the present paper, to enter into a particular description of the apparatus employed for producing the gas; but I may observe generally, that the coal is distilled in large iron retorts, which during the winter season are kept constantly at work, except during the intervals of charging; and that the gas, as it rises from them, is conveyed by iron pipes into large reservoirs, or gazometers, where it is washed and purified, previous to its being conveyed through other pipes, called mains, to the mill. These mains branch off into a variety of ramifications (forming a total length of several miles), and diminish in size, as the quantity of gas required to be passed through them becomes less. The burners, where the gas is consumed, are connected with the above mains, by short tubes, each of which is furnished with a cock to regulate the admission of the gas to each burner, and to shut it totally off when requisite. This latter operation may likewise be instantaneously performed, throughout the whole of the burners in each room, by turning a cock, with which each main is provided, near its entrance into the room.

The burners are of two kinds: the one is upon the principle of the Argand lamp, and resembles it in appearance; the other is a small curved tube with a conical

cal end, having three circular apertures or perforations; of a thirtieth of an inch in diameter, one at the point of the cone, and two lateral ones, through which the gas issues, forming three divergent jets of flame, somewhat like a fleur-de-lis. The shape and general appearance of this tube, has procured it among the workmen, the name of the cockspur burner.

The number of burners employed in all the buildings, amounts to 271 Argands, and 633 cockspurs; each of the former giving a light equal to that of four candles of the description abovementioned; and each of the latter, a light equal to two and a quarter of the same candles; making therefore the total of the gas-light a little more than equal to that of 2500 candles. When thus regulated, the whole of the above burners require an *hourly* supply of 1250 cubic feet of the gas produced from cannel coal; the superior quality and quantity of the gas produced from that material having given it a decided preference in this situation over every other coal, notwithstanding its higher price.

The time during which the gas light is used, may, upon an average of the whole year, be stated at least at two hours *per* day of twenty-four hours. In some mills, where there is over work, it will be three hours; and in the few where night-work is still continued, nearly twelve hours. But taking two hours *per* day as the common average throughout the year, the consumption in Messrs. Philips' and Lee's mill, will be $1250 \times 2 = 2500$ cubic feet of gas *per* day; to produce which, seven hundred weight of cannel coal is required in the retort. The price of the best Wigan cannel (the sort used) is $13\frac{1}{2}d.$ *per* cwt. ($22s. 6d.$ *per* ton), delivered at the mill, or say about eight shillings for the seven hundred weight.

Multiplying

Multiplying by the number of working days in the year (313), the annual consumption of cannel will be 110 tons, and its cost £125.

About one-third of the above quantity, or say forty tons of good common coal, value ten shillings *per* ton, is required for fuel to heat the retorts; the annual amount of which is £20.

The 110 tons of cannel coal when distilled, produce about 70 tons of good coak, which is sold upon the spot at 1s. 4d. *per* cwt. and will therefore amount annually to the sum of £93.

The quantity of tar produced from each ton of cannel coal is from eleven to twelve ale gallons, making a total annual produce of about 1250 ale gallons, which not having been yet sold, I cannot determine its value; but whenever it comes to be manufactured in large quantities, it cannot be such as materially to influence the economical statement, unless indeed new applications of it should be discovered.

The quantity of aqueous fluid which came over in the course of the observations which I am now giving an account of, was not exactly ascertained, from some springs having got into the reservoir; and as it has not been yet applied to any useful purpose, I may omit further notice of it in this statement.

The interest of the capital expended in the necessary apparatus and buildings, together with what is considered as an ample allowance for wear and tear, is stated by Mr. Lee at about £550. *per annum*: in which some allowance is made for this apparatus being made upon a scale adequate to the supply of a still greater quantity of light, than he has occasion to make use of.

Hé is of opinion, that the cost of attendance upon candles would be as much, if not more, than upon the gas apparatus; so that in forming the comparison, nothing need be stated upon that score, on either side.

The economical statement for one year then stands thus:

Cost of 110 tons of cannel coal	£ 125.
Ditto of 40 tons. of common ditto	20
	145
Deduct the value of 70 tons of coak	93

The annual expenditure in coal, after deducting the value of the coak, and without allowing any thing for the tar, is therefore — — — 52

And the interest of capital, and wear and tear of apparatus — — — 550

making the total expence of the gas apparatus, about £ 600. *per annum.*

That of candles, to give the same light, would be about £2000. For each candle consuming at the rate of 4-10ths of an ounce of tallow *per* hour, the 2500 candles burning upon an average of the year two hours *per* day, would, at one shilling *per* pound, the present price, amount to nearly the sum of money abovementioned.

If the comparison were made upon an average of three hours *per* day, the advantage would be still more in favour of the gas light; the interest of the capital, and wear and tear of the apparatus continuing nearly the same as in the former case; thus,

$1250 + 3 = 3750$ cubic feet of gas *per* day, which would be produced by $10\frac{1}{4}$ cwt. of cannel coals; this
multi-

multiplied by the number of working days, gives 168 tons *per annum*, which valued as before, amounts to

£188.

And 60 tons common coal for burning
under the retorts, will amount to 30

218

Deduct 105 tons of coak at 26s. 8d. 140

Leaving the expenditure in coal, after
deduction of the coak, and without al-
lowance for the tar, at — — 78

Adding to which the interest and wear and tear of apparatus, as before, the total annual cost will not be more than £650. whilst that of tallow, rated as before, will be £3000.

It will readily occur, that the greater number of hours the gas is burnt, the greater will be its comparative economy; although in extending it beyond three hours, an increase of some parts of the apparatus would be necessary.

If the economical comparison were made with oils, the advantages would be less than with tallow.

The introduction of this species of light into the establishment of Messrs. Philips and Lee, has been gradual; beginning in the year 1805, with two rooms of the mill, the counting-houses, and Mr. Lee's dwelling-house. After which, it was extended through the whole manufactory, as expeditiously as the apparatus could be prepared.

At first, some inconvenience was experienced from the smell of the unconsumed, or imperfectly purified gas, which may in a great measure be attributed to the introduction of successive improvements in the construc-

tion of the apparatus, as the work proceeded. But since its completion, and since the persons to whose care it is confided, have become familiar with its management, this inconvenience has been obviated, not only in the mill, but also in Mr. Lee's house, which is most brilliantly illuminated with it, to the exclusion of every other species of artificial light.

The peculiar softness and clearness of this light, with its almost unvarying intensity, have brought it into great favour with the work people. And its being free from the inconvenience and danger, resulting from the sparks and frequent snuffing of candles, is a circumstance of material importance, as tending to diminish the hazard of fire, to which cotton mills are known to be much exposed.

The above particulars, it is conceived, contain such information as may tend to illustrate the general advantages attending the use of the gas light; but nevertheless the Royal Society may perhaps not deem it uninteresting to be apprized of the circumstances which originally gave rise in my mind to its application, as an economical substitute for oils and tallow.

It is now nearly sixteen years, since, in a course of experiments I was making at Redruth in Cornwall, upon the quantities and qualities of the gases produced by distillation from different mineral and vegetable substances, I was induced by some observations I had previously made upon the burning of coal, to try the combustible property of the gases produced from it, as well as from peat, wood, and other inflammable substances. And being struck with the great quantities of gas which they afforded, as well as with the brilliancy of the light, and the facility of its production, I instituted several
experiments

experiments with a view of ascertaining the cost at which it might be obtained, compared with that of equal quantities of light yielded by oils and tallow.

My apparatus consisted of an iron retort, with tipped copper and iron tubes through which the gas was conducted to a considerable distance; and there, as well as at intermediate points, was burned through apertures of varied forms and dimensions. The experiments were made upon coal of different qualities, which I procured from distant parts of the kingdom, for the purpose of ascertaining which would give the most economical results. The gas was also washed with water, and other means were employed to purify it.

In the year 1798, I removed from Cornwall to Messrs. Boulton, Watt, and Co's works for the manufactory of steam engines at the Soho Foundry, and there I constructed an apparatus upon a larger scale, which during many successive nights was applied to the lighting of their principal building, and various new methods were practised, of washing and purifying the gas.

These experiments were continued with some interruptions, until the peace of 1802, when a public display of this light was made by me in the illumination of Mr. Boulton's manufactory at Soho, upon that occasion.

Since that period, I have, under the sanction of Messrs. Boulton, Watt, and Co. extended the apparatus at Soho Foundry, so as to give light to all the principal shops, where it is in regular use, to the exclusion of other artificial light; but I have preferred giving the results from Messrs. Philips' and Lee's apparatus, both on account of its greater extent, and the greater uniformity of the lights, which rendered the comparison with candles less difficult.

At

At the time I commenced my experiments, I was certainly unacquainted with the circumstance of the gas from coal having been observed by others to be capable of combustion; but I am since informed, that the current of gas escaping from Lord Dundonald's tar ovens had been frequently fired; and I find that Dr. Clayton, in a paper in volume XLI. of the Transactions of the Royal Society, so long ago as the year 1739, gave an account of some observations and experiments made by him, which clearly manifest his knowledge of the inflammable property of the gas, which he denominates "the spirit of coals;" but the idea of applying it as an economical substitute for oils and tallow, does not appear to have occurred to this gentleman, and I believe I may, without presuming too much, claim both the first idea of applying, and the first actual application of this gas to economical purposes.

On the Cultivation of the Common Flax, (Linum Usitatissimum of Linné,) as an ornamental Plant in the Flower-Garden. By Mr. JOHN DUNBAR, Gardener to THOMAS FAIRFAX, Esq.

FROM THE TRANSACTIONS OF THE HORTICULTURAL
SOCIETY OF LONDON.

THE Horticultural Society will perhaps honour with their attention a short paper, the object of which is to bring into cultivation the common *Flax*, as an ornament of the Flower-garden, not merely as such, but with a view to the profit it will afford, at least to the servant, if not to the master; and the interest of the former can seldom be promoted in an honest way, without some benefit

benefit accruing to the latter. This plant when so cultivated, like wax and honey, forms part of the natural riches of a country, and if it could supplant the cumbersome yellow *Lupine* in our Flower borders, the annual revenue arising from it would amount to several thousand pounds.

If gardening were in its infant state among us, a complete treatise on the culture of this plant might be necessary; but as this is not the case, only what is especially material will be noticed, with some directions how to prepare the plant after it is gathered. They are the result of several years experience, and by which a family consisting of five persons has been supplied with all the linen they required.

LINUM USITATISSIMUM.

Common Annual Flax.

- L. calycibus capsulisque mucronatis, petalis crenatis, foliis lanceolatis alternis, caule subsolitario.* *Hall. Helv. n. 836. Linn. Matt. Med. 90. Gmel. Sib. 4. p. 115. Mill. Dict. n. 1. Scop. Carn. 2. n. 381. Kniph. Cent. 9. n. 57. Knorr. del. 2. t. I. 9. Ludw. ect. t. 144. Hoffm. Germ. III. Roth. Germ. I. 139. II. 370.*
- L. ramis foliisque alternis lineari-lanceolatis, radice annua.* *Hort. Cliff. 113. Roy. Lugdb. 433. Phil. Bott. 261*.*
- L. foliis alternis lanceolatis integerrimis, calycibus acuminatis, capsulis mucronatis angulatis.* *Hort. Ups. 71.*
- L. sylvestre.* *Matth. 406. sativum plane referens. Baugh. Hist. 3. p. 492.*
- L. arvense.* *Baugh. Pin. 214. Ray. Hist. 1073. Neck. Gallob. 159.*

β. Linum

β. *Linum sativum*. *Baugh. Pin.* 213. *Blackw. t.* 160.

γ. *Linum sativum humilius*, flore majore. *Boerh. Lugdb.*

1. p. 284.

Λ. (*humile*) calycibus capsulisque mucronatis, petalis emarginatis, foliis lanceolatis alternis, caule ramoso.

Mill. Dict. n. 2. R.

ζ. *Linum sativum latifolium africanum*, fructu majore.

Tournef. Inst. 339.

Habitat hodie inter segetes Europæ australis.

The soil of every Flower-garden is always rich enough to produce good *Flax*; but if it is loamy rather than sandy, the quantity will be nearly double: even in the fields, which can never be cultivated with the nicety of a gentleman's garden, I have observed the greatest crops in a loamy soil, and that they yielded an article superior in quality as well as quantity: for as the durability of the fibre depends in some measure upon its size, there can be no doubt that tall and vigorous plants are preferable to small ones.

There are various ways of disposing this plant so as to be exceedingly ornamental, but none more so than scattering it in random parcels, or little clumps of from 10 to 20 plants, towards the back of the flower-borders, and in the front of the shrubbery: for without the summer proves uncommonly dry, it will attain to the height of three and four feet. If a temporary edging, or summer screen is wanting for any particular bed, it may be also employed for this purpose.

The seeds of good Flax are short, plump, thick, very oily, and of a bright brown colour. The best season for sowing them, in most gardens, is February, or the beginning of March, when the general crop of hardy
annuals

annuals are put in ; but if the ground be sandy, and naturally dry, they should be sown in *October* or *November*. No more attention than what is necessary for the other flowers in the garden, which is keeping down all weeds, while in the seed leaf, with a hoe, will be requisite for this. As soon as the seed begins to ripen, and the plants turn yellow, pull the whole up by the roots, and lay it in bundles exposed to the full sun, if the weather is fine, to dry completely. Then pull the heads off, and shake out the seeds. Immediately after, it must be laid to macerate in a ditch, or pond of water, and kept under by a long piece of timber floating upon it. From five to ten days is the time necessary for its immersion, and after the fifth, it must be examined daily, taking especial care that it does not lie too long. As soon as ever you find the fibres are sufficiently macerated to separate from one another kindly, spread it out to dry upon a new mown meadow. When dry it must be again collected into bundles, and either sent to the Flax dresser, or prepared for spinning at home by the gardener's wife. In many districts, this operation is well understood, and if carefully performed, home-spun linen from such *Flax* will last twice the time of most of the Irish linen that is now to be purchased in our shops.

I believe it is a great error to pull the *Flax* so green as is commonly practised, and a still greater to soak it in water, before it is previously dried : for the fibres require twice the time to macerate sufficiently for separation in the dressing : a process by which they are considerably weakened.

*Questions proposed by the Commissioners of Naval Revision,
respecting the State of Oak Timber; with Answers by
THOMAS DAVIS, Steward to the Marquis of Bath, at
Longleat, Wilts.*

From the LETTERS and PAPERS of the BATH and WEST
of ENGLAND SOCIETY.

March 1807.

QUESTION 1. 'Has the quantity of large oak timber in general, fit for the use of the navy, increased or decreased within the last fifteen years, in that part of the kingdom with which you are acquainted, naming the counties?—Has the quantity of ground planted with oak timber been greater or less than the quantity cleared by grubbing up underwood, or felling timber?—and where have any considerable plantations of oak timber been made?

Answer. 'Certainly decreased; I believe in most parts of the kingdom, but I can speak with certainty as to the counties of Wilts, Hants, Somerset, Dorset; and Devon.—Very little underwood has to my knowledge been grubbed up within the last fifteen years; though large tracts had been grubbed previous to that time.

'Very few plantations of oak timber have been made in that period, that have answered, or are likely to answer, (for reasons given hereafter;) although very extensive plantations of other trees have been made during that period, and with great prospect of success.

Question 2. Has the general consumption of oak timber for building, or other uses, in the country, increased

or

or diminished within the last fifteen years, and to what purposes has such timber been generally applied?

Answer. The country uses to which oak timber is applied in the West of England, are

1st. Building and carpenter's uses in general.

2d. Joiner's and cabinet-maker's uses.

3d. Wheelwright's uses.

4th. Millwright's use.

5th. Cooper's use.

In the 1st, the use of oak is in a great measure superseded by that of deal.

2d. In joiner's uses it is superseded by deal and foreign oak, and in cabinet-maker's by mahogany.

3d. Wheelwright's consumption *increased*, but in no great degree.

4th. Millwright's consumption much increased by the general use of machinery.

5th. Cooper's consumption is increased by the great demand for beer-barrels.

Upon the whole, the uses of oak for country purposes are decreased, and will be more so, as soon as oak timber is dearer than foreign deal, or deal become cheaper than oak. But there is in some other parts of the kingdom a great consumption (and I may say a great waste) of oak timber in the article of canal boats; and their locks use an immense quantity.

Question 3. Has the price of oak timber for carpenter's or country uses increased within the last fifteen years, and in what proportion?

Answer. Very much increased, but it ought to be remembered, that for *near a century before*, the price had been nearly *stationary*. I began selling timber in 1763, and at that time the price of oak timber of 20 feet

metings was 45s. per ton ; and I have no record or tradition of a less price than 40s. for 60 years before.

N.B. The ton is 40 feet *round* measure.

In 1791, which is a period of 28 years, the average price of oak timber (*of 20 feet per tree*) was then but 46s. 8d. or 14d. per foot.

In 1796, it was increased to 56s. 8d. or 17d. per foot.

In 1801, it was increased to 73s. 4d. or 22d. per foot.

In 1806, it was increased to 100s. or 30d. per foot.

So that the advance in the first 63 years of the last century, was little or nothing ; at the utmost only 5s. per ton.

In the next 28 years, the advance was only 1s. 8d. per ton.

In the next 5 years, it was 10s. per ton.

In the next 5 years it was 16s. 8d. per ton.

And in the last 5 years, it has been 26s. 8d. per ton.

The whole advance from 1763 to 1806 being from 45s. to 100s. or little more than double the value in 1763 ; not so much as the advance on cheese, butter, and many other productions of land, has been during the same period.

Question 4. Have the plantations which have been made within the last fifteen years, been chiefly of oak, or of the kinds of trees not fit for ship-building ; and to what cause do you impute the circumstance of one description of timber having been preferred to another in making plantations ?

Answer. Plantations are usually made on *high ground* for ornament, or on poor barren heaths or sand-lands, as the most profitable mode of application ; and oak is not the proper tree for land of that description. It will not bear exposure to the wind on high ground, nor will

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it make so quick and certain a return on poor sands, as beech, fir, or larch, or indeed almost any other sort of timber. In fact, notwithstanding the present high price of oak, it is less profitable to the planter than any other kind of timber whatever. The use and duration of English-grown fir and larch is now so well known and established, that it already supplies the use of foreign deal for many purposes; and it is to be hoped, the cultivation of these trees will be encouraged on a larger scale than has hitherto been, on land absolutely fit for nothing else. *Modern taste* condemns them, but national necessity imperiously demands their more general cultivation, and no trees will make so good a return to the planter.

Question 5. When plantations have been made of trees of different descriptions including oak, has the proportion of oak in general been such, where the soil was fit for the growth of oak, as, when the other trees have been thinned, the oak-tree remaining will be sufficient to cover the ground; and is it the practice to thin out the plantations, by taking the other trees and leaving the oak?

Answer. In plantations of firs on the kinds of land above-mentioned, it has been common to introduce oaks among the firs, and at 30 or 40 years growth to cut away the latter and leave the oaks; but it has answered no great purpose except that of ornament, as it was evident that the firs would have paid more for standing 20 years longer, than it was probable the oaks would do for standing 50.

Very few plantations of oaks have been made within my knowledge on land calculated for oaks, *viz.* cold stiff clays; and I am decidedly of opinion, that the expence of trenching and planting such land, and of keeping

ing the plants clean for so many years as are really necessary, will never answer the purpose of the planter, and of course will never be generally adopted.

The great hope of the nation must be in the increased growth of oak in woods already planted, and in the encouragement of the planting of all other sorts of timber, particularly elm and fir, to supersede the use of oak timber for country purposes, and thereby to leave a greater quantity of oak timber for the use of the navy. But still, as fir is not an everlasting tree (its continuance of growth not being much more than 120 years), and as elm is not at all fit for a plantation, it will always be advisable to introduce oaks in every plantation of fir, to cover the ground when the firs are gone, and to serve hereafter for country purposes; though no great dependence can be placed on them for the navy.

Question 6. Has any considerable quantity of oak timber been planted in consequence of the numerous enclosures of commons which have been made within the last fifteen years?

Answer. Very little oak timber has been planted in this way within my observation; and it is not probable that much will be planted. An oak is not a *farmer's favourite*; elms are always preferred, and indeed they are on all accounts the best hedge-row trees. But in countries where the enclosures are small, and where *oak* is the spontaneous growth of the soil, some dependence may be placed on hedge-row growth, if premiums are given to the hedgers for leaving the plants, (a penny a piece will do). By this means, an old enclosed country, almost denuded of trees, has within 40 years been again completely covered. This could not have been done by planting young trees on the banks in one hundred years,

years, though the expense would have been twenty-fold additional.

Question 7. What parts of the kingdom do you think the best suited for the cultivation of oak timber, either in respect of soil or climate, or owing to the land not being so applicable to purposes of agriculture as it is in other parts of the kingdom?

Answer. All cold strong soils are proper for oaks. The oak seeks its food in a close tenacious *under stratum*, where its roots can get firm foothold.

No part of the kingdom within my knowledge produces timber equal in quality and rapidity of growth to the counties of Hants and Sussex: soil in general, a strong clayey loam. The county of Hereford, and those parts of Monmouth and Gloucester which adjoin thereto, stand next. The soil a red strong loam, but rather inclined to sand. The strong clays and dingles of Devonshire are very kindly for oak timber, but the quantity is very much reduced there.

The cold clay lands which lie at the roots of the chalk hills, through the South and West parts of the kingdom, are a favourite soil for oak, and there are many choice spots in Wales.

In fact, as oak does not require rich land, it will, at its present price, pay as great a rent for the land on which it grows, as the land will produce under any other appropriation.—The fact was otherwise 20 years ago, which occasioned the destruction of many woods. The great advance in the value of timber, and the probability that it will still continue to advance, will preserve the rest.

Question 8. Have owners of woods become more careful, in enclosing and protecting them, than formerly,
in

in consequence of the increased value of timber of late years ; and do they leave a greater number of standard trees, when they cut the underwood, than was formerly in practice ?

Answer. Most certainly they do become daily more careful in preserving woods than for many years past, and a greater number of standards are left than heretofore ; and more will still be left as soon as the old prejudice wears out, "*that timber and underwood are not good companions.*" The reverse is the fact. Neither will grow alone to pay interest, equal to *both together*. The loss of 2l. per acre in the underwood, will be compensated by 10l. worth of timber, for the underwood shelters the timber and accelerates its growth. In the great oak woods on the banks of the Severn and Wye, which are cut at about 18 years growth for the iron furnaces, not a standard is left for timber in hundreds of acres. They indeed leave them in great numbers for 2 rounds, (viz. 36 years) and then cut them for laths, &c. when they would pay 10 per cent. for standing for timber ; and so far from being the worse for growing on a stool, they will (provided the stool is young and healthy) grow with twice the rapidity that a maiden-plant will. Mr. Wm. Partridge, (of Monmouth,) who owns considerable woods on the Wye, has tried this with wonderful success, particularly in a fine wood called Penyard, near Ross, which he has already filled with fine thriving trees ; *but no coppice-wood for sale should ever be cut by the buyer.* It is too strong a temptation to cut the saplings. The seller should always cut the wood, and leave the saplings himself, before he sells it.

And it should be particularly explained to all owners of oak woods, especially of those where no plants have been

been left for two or three successive falls, not to be afraid of leaving poles which grow from a stool, especially if that stool was a plant cut off at the last fall, or the preceding one; and the root is vigorous. There is no other way of filling a neglected wood with timber in so short a time; and the rapidity of the growth of those stool-plants will draw up the maiden plants, which otherwise linger and are smothered with the underwood; *for no wood, especially of oak, grows well unless the tops are unequal in height.* The leaves of a young oak are as tender as the wings of a young butterfly, and the first spring blast whips them to pieces, unless protected by others of a superior height whose branches are stiffer; on this account, timber and underwood grow best together. The latter shelters the bodies of the timber trees, and the timber trees protect the tops of the underwood and of the saplings from the wind.

Question 9. Can you suggest any means by which the owners of oak timber might be induced to postpone the cutting of it until it should be of sufficient size for naval purposes, and of securing to Government the first offer of that timber?

Answer. This can only be done by Government's giving such prices for *large* timber, as no individual can afford to do for country uses. Hitherto *they have not.* At the present or at any former period, it was never worth while for an individual to send a single oak tree to the dock-yards, if the distance was more than 30 miles; although the size and shape of that tree was such, that the building a ship of war was stopped for the want of it. And it must ever be so, while the contractors sell to the yards by metings, (or average *measure*,) instead of having a fixed *progressive* price for *every tree* according

to its size and use. The contractors charge Government quite enough (especially when their mode of measuring is considered) for large pieces; but the *growers are not told* the real value, but only the average price, and can get no more. Many hundred valuable pieces are therefore cut up yearly for very unworthy purposes, which were *really* worth to the navy four times the money they were sold for.

Question 10. Can you suggest any other means by which Government might obtain supplies of timber for the navy, or by which owners of land might be induced to plant oak timber, and by which the protection of the plantations might be secured?

Answer. This question naturally divides itself into two, viz.

1st. Is there oak timber enough in the kingdom, provided that Government could get its due share of it?—Or is there not; and are we driven to the necessity of planting more, and waiting till it be grown?

I think, as much as I sincerely hope, that the latter is not the case; great falls have been certainly made lately all over the kingdom, but much greater attention has also been paid to the preserving young trees than formerly.

I therefore combat only that part of the question, viz. that there is oak timber enough in the kingdom fit to cut yearly, provided that Government could get its share of it; and I say there is, but they never will, till they *can get the monopoly by advancing the price*. It has been calculated that Government do not get one seventh part of all that is cut in the kingdom. And why may they not get a *full half*? They might, if they would give its *full* value. If they will not, it will be cut up for
country

country uses; for oak, notwithstanding its high price, is a full-third lower than deal, and as cheap or cheaper (considering its durability) than any other kind of timber.

General Question. Can you furnish any other observations or information on the subject?

Answer. The part of this subject which appears to me most involved in difficulty arises out of the answer to the first question; viz. "that the quantity of *large oak timber* has decreased very rapidly within the last 15 years, but particularly *within the last five.*" The advance in price has nothing to do with this, nor even the temptation of the enormous advance in the price of bark; for had not the timber been wanted, it could not have been sold. The honourable Commissioners of Naval Revision can best tell whether the demand for naval purposes has so far exceeded its former bounds; if not, much more timber has been appropriated to country purposes than formerly; or, it is possible, the great falls of timber within the last few years may have been chiefly in the West of England, under my own observation.

From the foregoing answers to the questions proposed to me by the Commissioners, my opinions on the subject may be deduced; and which I will endeavour here to bring into one point of view.

The great *desiderata* to obviate the scarcity of oak timber for naval purposes are these;

1st. To keep up a full crop of *all* kinds of timber in the kingdom; and

2dly. To secure for the purposes of ship-building whatever timber Government may want; and particularly *large oaks.*

I. To attain the first object, encouragement must be given to the growth and preservation of all trees which

come up spontaneously, such as oak and elm; and to the planting of all other kinds, particularly Scotch fir and larch, so that there may be timber enough grown in the kingdom to supply its domestic wants.

II. And to attain the second object, (but which certainly depends very much on the attainment of the first;) let Government offer such high prices for *large useful pieces of oak timber*, as will insure the monopoly of them to themselves against all bidders for country purposes; and let the *size*, and *shape*, and *price* of those pieces be *engraved and distributed publicly*, that the growers of timber may know what each piece is actually worth, or will probably be worth, if the cutting thereof were deferred a few years; growers would then be a match for contractors! At present, the finest *stern-post* or *rudder-piece* that ever grew is worth more money in this country to cut into *inch and quarter board*, or even into *barrel-staves*, than it would sell for to go into Portsmouth yard; and the price of knees is so trifling, that they are much oftener used for firewood, than preserved for the navy.

General Inferences respecting Timber.

Timber is a production of the soil, and must be raised at a certain expense to the owner of that soil.

To induce the owner of soil to promote the growth of any particular production thereof in preference to another, it will be necessary to convince him that his soil will thereby make a greater return than under any other mode of application. Now, until the last five years, the growth of timber has made a less return for the soil on which it grew, than any other production would have done. *Ergo*, the growth of timber has not been the best application of the soil; and the consequence has been, that the quantity of
wood

wood land has decreased, to make way for other productions of the soil, viz. corn and grass, until the period when its return is become equal, or nearly so, to that of corn or grass.

Again,—Admitting the price of timber to be so much advanced, that its return to the owner of the soil shall be equal, *upon an average of the different sorts of timber*, to the return from any other production of the soil; the owner of the soil will then consider what sort of timber makes a *less* return than other sorts, and will discourage that and prefer the others. Now, oak timber, even at its present price, makes a less return than any sort of timber whatever; *ergo*, the growth of oak timber will not be encouraged at its present price.

But *à fortiori*, if the cutting of oak timber is to be protracted to double the time necessary for the growth of other timber, viz. from 60 or 80 to 120 or 160 years, the owner of the soil will then consider how he is to be remunerated, not only for the use of his soil, but for the *accumulating interest* of his capital. And no calculation will prove the possibility of this, even at the highest price ever yet given for the largest oak timber. *Ergo*, the preservation of large oak trees for the navy cannot be expected *as a matter of profit to the owner of the soil*; and patriotism alone will go but a little way towards furnishing the necessary supply.

General Corollary.

Admitting that the return to the owner of the soil for the growth of timber, *in general*, is equal to the return from the growth of corn and grass, yet that from oak timber is not. Therefore the price of oak timber is not yet high enough; and as no calculation
for

for the *interest of the value*, as well as for the time of growth, is ever made, on *large oak* timber, the present highest price given for the navy bears no proportion, or a very small one, to its real value. And as no reduction in the price of other sorts of timber can be expected, while the return is but barely equal to the rent of the land, that of *oak*, and particularly of *large oak*, must be materially increased, *to insure the preservation of any oak timber at all.*

List of Patents for Inventions, &c.

(Continued from Page 216.)

RICHARD TREVITHICK, of Rotherhithe, in the county of Surrey, Engineer, and ROBERT DICKINSON, of Great Queen-street, in the county of Middlesex, Esq.; for certain Machinery for towing, driving, or forcing and discharging ships and other vessels of their Cargoes. Dated July 5, 1808. Specification to be enrolled within six months.

WILLIAM PROCTOR, of Sheffield, in the county of York, Optician; for improved methods of melting and using malleable wrought iron or steel. Dated July 6, 1808. Specification to be enrolled within four months.

JAMES BROWELL, of Cornhill, in the city of London, Tailor and Draper, JAMES JACKS of Cornhill aforesaid, Tailor and Draper, and THOMAS LENNITTE, of Aldgate, in the said city of London, Man's Mercer; for a new chemical preparation for the purpose of preserving from destruction by mildew, rot, or fermentation—

mentation, all kinds of woollen and vegetable substances from which woollen, cotton and linen cloths, canvas, paper and other manufactures, are made; and also for rendering all sorts of woollen, cotton and linen cloths, canvass, silk, leather, hats and paper, impervious to rain, by an improved method. Dated July 11, 1808. Specification to be enrolled within two months after the next sitting or session of the Parliament of our United Kingdom of Great Britain and Ireland.

JOHN HEATHCOAT, of Loughborough, in the county of Leicester, Manufacturer; for a machine for the making or manufacturing of bobbin-lace, or lace nearly resembling French lace. Dated July 14, 1808. Specification to be enrolled within one month.

JAMES LINAKER, of our Dock Yard, Portsmouth, Master Millwright; for a method or methods of towing, driving, or forcing ships and other vessels. Dated July 14, 1808. Specification to be enrolled within one month.

BENJAMIN CROSBY, of the parish of Saint Martin Ludgate, in the city of London, Bookseller; for a stand for books, which may be made either circular, square, or any other convenient shape, and may be turned or moved at pleasure, with cases to receive books, as well as various other articles and things. Dated July 25, 1808. Specification to be enrolled within one month.

WILLIAM HAWKES, of Newport, in the county of Salop, Esquire; for improvements on musical keyed instruments of twelve fixed tones. Dated July 25, 1808. Specification to be enrolled within one month.

GEORGE

GEORGE RICHARDS, of Truro, in the county of Cornwall, architect; for single and double cannon, cannonades, or ordnance, musquets, and all other kind of fire arms, on a new principle, and a new method of charging or loading the same, and of fixing or placing bayonets on fire arms. Dated July 30, 1808. Specifications to be enrolled within four months.

JOSEPH MASON GUEST, of Birmingham, in the county of Warwick, Thread Manufacturer; for an improved mill for twisting thread for various purposes. Dated July 30, 1808. Specification to be enrolled within one month.

JOHN CURR, of Belle Vue House, in the parish of Sheffield, in the county of York, Gentleman; for a method of applying flat ropes, flat bands or belts of every kind, to capstans and windlasses of ships and vessels of every description, for the purpose of towing or conveying the said ships and vessels in, out of, or about Ports, Harbours, Rivers, Seas or Creeks, and also a method of applying flat or round ropes, lines, bands or belts, for the purpose of catching and detaining whales. Dated July 30, 1808. Specification to be enrolled within four months.

LUKE HEBERT, of the parish of Saint Stephen Walbrook, in the city of London, Gentleman; for a machine on an improved construction, for polishing, embossing, and graining leather, and extending and flattening the same. Dated July 30, 1808. Specification to be enrolled within one month.

THE
REPERTORY
OF
ARTS, MANUFACTURES,
AND
AGRICULTURE.

No. LXXVII. SECOND SERIES. Oct. 1808.

Specification of the Patent granted to JOHN HALL, of the Town and County of the Town of Kingston-upon-Hull, Rope-maker; for certain Improvements in making and manufacturing Ropes and other Cordage, and coiling of Lines in Whale Boats. Dated June 28, 1808.

With a Plate.

TO all to whom these presents shall come, &c. NOW KNOW YE, that, in compliance with the said proviso, I the said John Hall do hereby declare and ascertain the nature of my said invention, and the manner in which the same are to be performed, used and exercised, as follows; that is to say: I give a regular turn or twist in all the threads or yarns spun by hand equally alike, by making use of a double wheel for spinning the same; the large or major wheel turns the spindles, the small or minor wheel turns the regulating belt, which belt may be made of any fit material, and placed in any situation so as the spinners can see it. The most conveni-

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P p ent

ent method is to fix two pullies above the minor wheel, a sufficient height above the men's heads, over which the belt travels, and above the beams down to the bottom of the walk, where another pulley is fixed, round which the belt is placed, and brought up again and the ends fastened together; upon the belt I fix a piece of red cloth or any other conspicuous marks, in number equal to the sets of spinners I have occasion to employ, taking care that the marks are placed at equal distances from each other to correspond with the spinning; the two wheels travelling on the same centre make a revolution in the same time. For spinning yarn of twenties, I make use of a minor wheel of ten inches diameter to a major wheel of five feet six inches, and spindles of two inches diameter; the minor wheel must be increased or diminished in size at the rope-maker's discretion, according to the different-sized yarn required; other sized wheels may be used for the same purpose in the proportion above described. The marks being adjusted, I set two or more companies of spinners to work, one man in each I select as head over the rest, and charge him to keep his men together; when the guide mark is at the wheel, the first company hang on their hemp, the man turning sets the wheels in motion, the major turning the spindles, the minor turning the belt; the regulating mark will then travel down the walk which the men keep pace with in a body; by so doing, and spinning the threads a proper thickness, they will have the same regular turn in them from one end to the other. Having finished their threads and arrived at the bottom, they are taken off the wheel, and made fast to a large hook placed near for that purpose, drawn tight, and the ends loosely fastened to a similar hook fixed at the bottom, the threads remaining
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in the crooks all the way ; to remove which, I employ a boy with a rod, having an iron ring at the end with a vacancy to admit placing the yarns in it, to unhook the threads from the crooks, and place therein a large hook hung to the beams for that purpose. The first company having got half way down the walk, one of the side marks will be at the wheel ; and the second company must then hang on their threads and spin down in the same manner as the first ; when arrived at the bottom, they unloose the threads first spun from the hook they are made fast to, and knot the end of theirs to them, leaving the bight of the threads over the end of the hook, which threads are taken off the wheel, drawn tight at the top end, and loosely made fast to the top hook ready to knot the succeeding threads to. The boy passing up with his rod places the threads in the large hooks ; the spinners proceeding in this manner, and knotting their threads to the ends of the preceding ones, and placing the bight over the hooks at each end, will keep adding to the hank suspended in the large hooks down the ropery, and resting at each end on the top and bottom hooks : the boy employed to unhook the threads must nettle them where required. An equal number of men must be employed in each company of spinners. The hank having increased sufficiently large, the whole are then slightly twisted together with the hooks they rest on, and removed into the tar house ready for that operation. I likewise place a double spinning wheel at the bottom of the walk, or at any distance down it I require the length of my yarn to be, the wheel being placed on a moveable frame for that purpose. The belt being fixed round the minor wheel similar to the one at the top, it is drawn tight from the upper wheel, and the

regulating marks adjusted. The men having spun down and fastened their threads to the low hook, hang on to the low wheel, and spin up in company with the regulating mark in the same manner as they spun down. Having arrived at the top, their threads are taken off the lower wheel, and knotted to the ends of the threads spun down, and the bight of the yarn is left over the bottom hook; they are drawn tight at the top and loosely fastened as before; the boy with his rod removes the threads into the large hooks, which for conveniency of receiving the threads spun down and up should be double; the threads of the hank spun down are placed in the left side, and those spun up in the right side of the double hook. The men in this manner spinning alternately down and up, and knotting their threads to each other as they are spun, will keep adding to the hank suspended in the walk; the spinners going down pass on the left, and those coming up pass on the right hand side of it; and for the conveniency of catching the threads as they are spun up, the thread hooks on the right of the hank must be placed in a contrary way to those on the left. The belt travelling on both the minor wheels, it is necessary for the turners at each of the spinning wheels to keep pace together; the hank when full is treated as before described.

By taking the regulating belt from off the wheels, I spin common yarn in the same way down, or down and up, knotting the ends together to form the hank, and placing it in the large hooks; or hang it to the sides in any convenient situation, by which method I save in time and labour. The low wheel being moveable can be placed at any distance down the walk the yarn is wanted to be in length. The operation of tarring I perform in
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the usual way (if the rope is to be white, the tarring is omitted); after which the yarn is extended upon the slots and made into rope. The sledge or laying wheel being placed at the distance required, I hang on to three separate pinions or hooks as many yarns as wanted, first entering the ends through a fair leader which is mounted upon wheels; the yarns being clear all the way, the upper ends are put through another fair leader at the top, drawn tight from the sledge and placed upon reels. To give the yarns a proper tension, a spring is fixed upon the reels, which prevents them yielding the threads faster than required in laying the strands. The men at the sledge are then to turn, and the fair leader is moved forward as fast as the strands are twisted to the top, which done they are cut off and closed in the usual way. Care must be taken that the men turn the wheels with a regular motion during the operation.

In the following manner I make double-thread strand cordage. The bottom wheel being placed at any distance down the walk I require the yarn to be in length, and the regulating belt fixed upon the minor wheels of each spinning wheel; the hemp being dressed, I calculate the quantity required to make the yarn intended to be spun, and weigh it out to each spinner, that my threads may be alike. My companies consist of two or three men in each, as I want a double or a treble-thread; set on to the upper wheel, and spin down with the guide mark, place their threads upon bearers or stake heads; having arrived at the bottom, the ends are knotted together, and hung upon a looper fixed to a small drag; the wheel still turning, a boy puts in a top, walks up with it and closes the threads together; it is then hung upon
a spindle

a spindle at the top, taken off the looper and hung upon the drag at the bottom, and hardened into a cord ; when finished, it is placed to a side, or hung in the large hooks suspended in the walk ; the spinners having finished their threads down and knotted the ends together, leave the boy to close them, set on to the low wheel, and spin up again in company with the guide mark ; the threads spun up are closed in the same manner by the boy as those spun down, and the ends are fastened together to form a hank as before. The men proceed in this manner until I obtain a quantity of those double threads or cords, which I tar in the usual way, and make them into strands, by first laying the heart of a small number of the double threads or of yarns, and placing the cords around the heart similar to the making a four-strand rope. The cords previous to laying are put through the fair leader and upon the reels, so as to have a proper tension during the time of forming the strands, which strands I make into three or four-strand shroud or warp-laid ropes, and I combine them together by sowing them, in which case they will be found serviceable for mines or pits ; every other one of the combined double-thread strands must have a contrary twist in it, to prevent it from turning when loaded with heavy weights. In combining these strands I make use of two needles which penetrate through the centre of each, and the threads cross each other and form a diamond. Whale lines I make by combining in the same manner a plural number of these strands together ; of whatever number of strands the line is to consist, the whole I make upon the same wheel at one time, regularity being required in forming them. And to prevent the lines from intangling when in use,

I coil

I coil them on reels in the fishing-boats ; at one end of the reel I fix a gripe wheel with a brake to it : the fish being struck with the harpoon, one of the crew takes hold of the brake and lets out the line at pleasure. The round lines I coil in the same manner upon reels, by which method they cannot foul and endanger the lives of those men in the boats.

In making of warp-laid ropes, I claim as my invention a wheel containing nine spindles, whereby I make the whole of the strands at once, which method puts a regular turn in them equally alike. The wheel may be of any size according to the power required to make a large or a small rope. To prevent the yarns from getting foul of each other by making nine strands at the same time, I use three bearers or slots, which are placed one above the other, by which means each strand is kept separately by itself. When the strands are sufficiently hard, I hang each three strands upon three separate pinions, and close them by three tops fixed upon a carriage which moves forward as they are laid. The strands thus formed are hung upon the spindle of the wheel which is constructed for that purpose, and made into a cable or warp.

Fig. 1, (Plate XI.) shews a front view of the spinning wheel, with the minor wheels and regulating belt fixed upon it.

Fig. 2, side view of the same, *a a* in both figures is the regulating belt, *b* the guide mark fastened to the belt, *c c* the spinning wheel, *D* the minor wheel with the belt upon it, *e e* the belt which turns the spindles, *g g* two sheeves placed above the minor wheel over which the belt travels down the walk.

Fig. 3,

Fig. 3, the minor wheel detached from the major; as various-sized minor wheels are wanted for spinning of different sized yarns, the minor must be made to ship and unship from the major wheel.

Fig. 4, two hooks, a double and a single one, to hang the threads or yarns in as they are spun; the double hook has a joint in it to turn up clear of the men's heads when not in use.

Fig. 5, the combined double-thread strands showing the diamond stitching.

Fig. 6, inside view of a whale-boat with the reel fixed in her and the line upon it; *n n* the line as it runs off the reel *m*, and *s* the brake handle, *o* head of the boat, *p* her stern, *r* the bollard which the line may be taken to and used in the common way in case any accident happen to the reel.

Fig. 7, the reel and line detached from the boat; *t t* the spindle upon which it travels.

Fig. 8, end of the reel shewing the gripe wheel *u*.

Fig. 9, the gripe which is fixed upon the wheel *u*. The boats I most approve of are those built upon the plan of Messrs Harper and Wilson's patent, they being much more capacious, lighter, stronger, and less liable to leak or be bulged by the ice, than those made in the common way.

In witness whereof, &c.

Specification

*

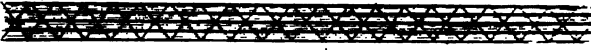


Fig. 5.

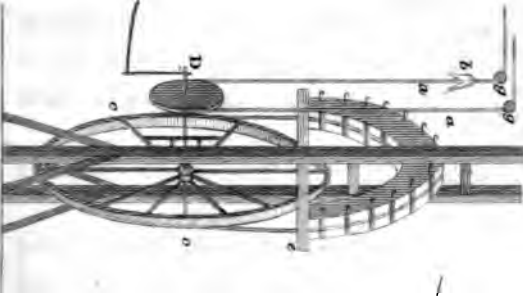


Fig. 2.



Fig. 9.

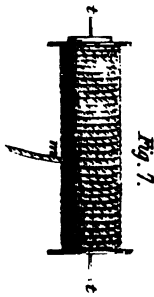


Fig. 7.



Fig. 8.



Fig. 4.



Fig. 3.

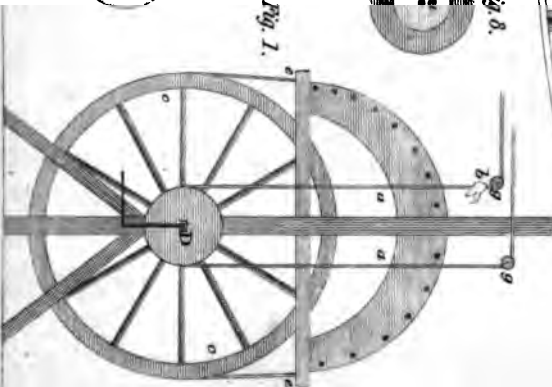


Fig. 1.

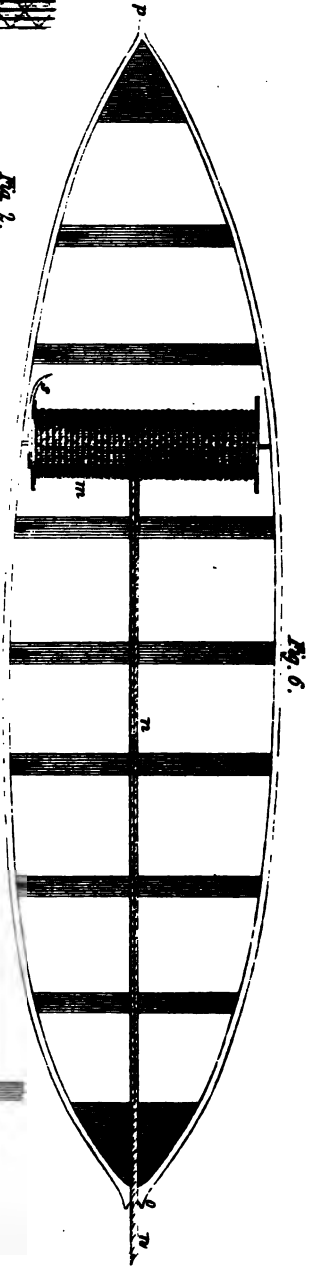


Fig. 6.

Specification of the Patent granted to JOHN CURR, of Belle Vue House, in the Parish of Sheffield, in the County of York, Gentleman; for a certain Invention of spinning Hemp for the Making of Ropes or Cordage.

Dated March 8, 1808.

TO all to whom these presents shall come, &c.
 NOW WITNESS THESE PRESENTS, that the said John Curr, by this present instrument in writing under his hand and seal, doth describe and ascertain the nature of the said invention and manner in which the same is to be performed, used, and exercised as follows; that is to say: To the axis of the spinning-wheel usually applied for spinning hemp for cordage, annex a small drum made of tin, wood, or other fit material, about twelve inches diameter, which may be about twenty inches or two feet long, upon which small drum a small cord, wire, or chain, or other fit material, must be wound, of the length at least of the thread proposed to be spun; and by turning round the spinning-wheel which commands the spindles, the small cord, wire, or chain, or other fit material (which should be annexed or fastened to one of the spinners), will at the same time turn off the drum, and give the speed the spinners must go. If the spinners want to go a quick speed, the spinning-wheel will require to be turned quick, and if slow the wheel must be turned slow; and it will be necessary to proportion the drum herein explained to the wheel and spindles, in such manner as to give the desired twist to the yarns, which for the making of a rope is of very considerable importance; and if for different uses it is required to have the yarns spun harder or softer, the introduction

of larger or smaller whirls will produce the desired effect. It will be adviseable to have all the whirls of one and the same size, that are in use at the same time, and all the spinners employed upon one wheel to begin and end their threads together, and keep the same speed, as near as may be, with the person to whom the cord, wire, or chain is attached, to produce in all the threads the most regular twist possible. By more complicated machinery, the cord, wire, or chain, that points out the speed to the spinners, may be used and applied in a different manner, or a distinct person may carry the cord, wire, or chain to give them the speed; but what I lay claim to as my invention, is a cord, wire, or chain, or other fit material, connected or applied in any way with the spinning-wheel and the spinners of the yarns, which may to any convenient distance keep up a regular connection between them. All the yarns being spun with one twist, will make them stretch nearly alike, during the operation of using the rope, as well as that of laying the rope; and when the yarns are not equally twisted, and the strands are twisting up during the operation of laying, the yarns are in part untwisted again, which generally produces the effect of giving an unequal tension to the strands, which defect the rope-maker generally remedies (in order to make the strands lay well in the rope), by twisting up or untwisting one or two of the strands; but if the strands that compose a rope have an unequal number of twists, they cannot when applied to use take an equal share of the burthen.

In witness whereof, &c.

Specification

Specification of the Patent granted to JOHN HARRIOTT, of Wapping, in the County of Middlesex, Esquire; for a new Fire Escape, or Machinery to be used in Cases of Fire. Dated May 10, 1808.

With a Plate.

TO all to whom these presents shall come, *&c.* NOW KNOW YE, that I the said John Harriott, in compliance with the said proviso, do hereby declare, that the nature of my said invention and the manner in which the same is to be performed, is particularly described and ascertained in the drawings hereunto annexed, and the following description thereof; viz. The nature and principle of this invention or improvement for furnishing the means of escaping from a house or building when on fire is very simple, as shewn by the annexed drawings and the following description. The internal or chamber fire-escape consists in having a fastening made of wood, iron, or other metal, in the nature of a small crane, as shewn by No. 1. (Plate XII.) or in the nature of a hinge as seen by No. 2, to fix to the bottom, top, or sides of any window, or other opening in any house or building. At the projecting end of this fastening or fire-escape there are two holes, as seen A A in No. 1 and No. 2, through both of which a rope is to be reeved or passed, as shewn A A No. 1. At one end of this rope an eye is to be spliced or tied for the other end to pass through, which then forms a slip noose B. The rope is to be long enough not only to reach from the window to the earth when doubled, but to extend several feet more, slanting from the building; a small line is likewise to be added C, fastened to the noose. This is all the apparatus wanting for the chamber fire-escape (though a pulley and block, and other things may be easily added if required), and may be applied or put to use in the

Q q 2

following

following way; the chamber fire-escape may be made to ship and unship at pleasure, and may be shaped variously, and being secured to the bottom, top, or sides of any window or other opening, with the rope passed or reeved through both holes at the projecting end, the plain end of the rope is to be dropped or thrown down to any person on the outside to take hold of and to lower down the person to be rescued. Persons to be rescued have only to slip the noose over the head and shoulders, so as to draw the noose close just under their arms, and getting out of the window, any other person or persons below or remaining in the room, having hold of the other end of the rope may lower them down in safety; and then if men are to be rescued from the same floor, the noose is to be hauled up again, and the same process to be repeated as often as necessary. The small line fastened to the noose is for the purpose, of drawing the suspended person clear away from the side of the building when found needful. When there are several people thus to be saved, those who remain in the room may lower down the others; those first down may then lower the rest, and a moderately active person would find no difficulty in lowering himself down, more especially if the small end of the rope is again reeved through another hole or two, provided for the purpose in the sloping bar, as shewn in the drawing at D D, No. 1. to deaden its passage still more.

For the external fire-escape or machine, for moving from house to house, the following description, with the drawing No. 3, will clearly shew the instrument, and how it is to be applied. The drawing No. 3 shews an instrument on the same principle, though it may be variously shaped, made of iron or other metal to be fixed on the end of a pole of a length proportionate to the

the

the height of houses in the neighbourhood, so that it shall reach and rest upon, clasp or take hold of any window cill it shall be elevated to. At the upper or projecting end outwards, there are to be two holes with a rope reeved or run through them, exactly the same as the one described for the chamber fire-escape. One end of the pole is to be fitted and fastened into the socket of the fire-escape, by which the fire-escape machinery may be raised full as readily as a ladder, furnishing a similar means of escape from without, as that of the chamber fire-escape from within. The lower part of the pole may be divided by a joint, so as to straddle and stand firm, as shewn by the etching drawing of a front view of No. 4, of the same machine as is delineated No. 3; and these legs E E may be opened more or less by a line F, to heighten or lower the fire-escape at the top, to suit the place to which it is to be raised; or two poles may be made to slide one up by the other, until the upper end having the fire-escape can be lodged on its destined situation; or it may be made in other ways to suit particular situations.

The external fire-escape, as shewn by No. 5, is on a different construction, formed on the principle of the idler or lazy tongs; it is made of bamboo canes, or deal, or other wood, or metal, in slips of any even lengths, according to the size and elevation intended; five double lengths, or more or less, or ten pieces of eight feet long each, or any other length, are to be bolted in pairs together in the centre of each length, but so as to work easy on those bolts. The ends of each adjoining pair are likewise to be bolted together, one pair to another, until the five pair or other number thus bolted together, lay edge-ways one over the other. There must be two or more sets or rows of these bolted pairs of bamboos, slips
of

of wood, or metal. These two or more sets are to be secured together at any required distance by bolts the length of said distance. To the four corners or upper end a canvas or netting may be fastened, or a slight platform, as shewn in the drawing at G. No. 3. which thus forms a top to be raised up to the windows of houses where people are to be rescued, or help is wanted to be sent up to the chambers. The lower or bottom ends of the bamboos, or slips of wood, or metal, are to be fitted to and rest upon the bottom of a case, fixed on four wheels like a truck, to move readily to any place where wanted, until the platform or top is required to be raised to any window; the whole of these double rows or sets of bamboos, or slips of wood, or metal bolted together to form one piece of machinery, will lay down close in the case, not exceeding two feet in height. But when a force is applied to raise the machinery, it will extend to a height not exceeding thirty feet, raising the platform or canvas, or netting top, either to receive any person from out of a window, or convey any person up to give ready aid of any kind. By raising the lower middle joint or bolt that secures the sets together, between three and four feet from the bottom of the case, the top will be elevated more than thirty feet, a greater or lesser number of lengths giving a greater or less height. The power to be applied for raising the lower joint or bolts may be various; it may be by the common rack and pinion-wheel of the timber jack, or by a lever, or by a common pulley, or by a rope round a roller worked by a tooth and pinion wheel with a winch handle, as shewn in the drawing No. 5. In either way the raising and lowering of the platform, or canvas or netting top, is performed with the greatest celerity, by which people goods may be saved; and may be applied to various or good purposes. In witness whereof, &c.

Specification

*Specification of the Patent granted to WILLIAM COBB, late of the Parish of Saint Martin in the Fields, but now of Switkin's Lane, Cannon Street, London, Cordwainer; for a Method of making an Air Jacket and proper Shoes for Swimming, to prevent the fatal Consequences attending Sailors and others in Shipwreck, never heretofore practised. Dated March 31, 1764 *.—Term expired.*

TO all to whom these presents shall come, &c. NOW KNOW YE, that in compliance with the said proviso, I the said William Cobb do declare, that my said invention does consist and is to be performed in manner hereafter expressed; that is to say: The jackets are made of calves, neat, or sheeps leather, or any thing pliable that will hold air, cut in the form of a short jacket without sleeves, with pieces sewed on the outsides and back bigger than the insides or back to hang loose and hollow, to contain a sufficient quantity of air blowed through a bag or receptacle, with a pipe fixed to it to convey the air into the receptacle, which receptacle is fastened on to one of the loose sides to convey the air into the loose sides and back, by means of a communication from one part of the jacket to the other. The jacket to be buttoned before, button-holes round the skirts to be buttoned or fastened to the waistband of the breeches. The upper strap of the receptacle to be buttoned to the upper button of the jacket, and the lowest strap to the nearest lower button it comes to. Then

* The air-jacket described in this specification is so similar to Mr. Daniel's life-preserver, which the Society of Arts, &c. have lately rewarded with their gold medal, that we have been requested to publish it along with the account of that gentleman's apparatus, which will be found in the present number.

hold

hold the pipe with your teeth and blow into the receptacle till the jacket is filled with air, stop the pipe with the cork, then use it in swimming.

The shoes are made with pieces of wood cut in the form of a sole of a shoe, and hinges screwed on to the wood with joints covered with leather, fastened on to common shoes, to open and shut in swimming like a swan's foot.

In witness whereof, &c.

Specification of the Patent granted to EDWARD COLEMAN, Professor of the Veterinary College, in the Parish of Saint Pancras, in the County of Middlesex; for certain Improvements in the Construction and Application of a Horse-Shoe, which will completely prevent several Diseases to which the Feet of Horses are subject, more especially that very general Disease called Contraction of the Hoof; and is also particularly adapted for flat or convex Feet for Horses of the Cavalry and for Hunting, and for all other Purposes where the Loss of a Shoe is productive of great Inconvenience.

Dated April 30, 1808.

TO all to whom these presents shall come, &c.
NOW KNOW YE, that in compliance with the said proviso, I the said Edward Coleman do hereby declare that my said invention is described in manner following; that is to say: As all cases of contracted feet in horses proceed from the hoof being exposed to artificial and unnatural heat in the stable, or from the frog not receiving its due degree of pressure; and as the frog of the horse when shod can rarely be made parallel with the heels of the shoe, it was deemed very important to invent a shoe
 applicable

applicable to all horses feet, and which would prevent the contraction of the heels, although the frog was not in contact with the ground. And as the nails of the shoes are frequently broken, loosened, or altogether lost, and the shoe thereby prematurely removed from the horse, and the horse in consequence often lamed, and always rendered unfit for use until again shod; and as the inconveniences from the loss of a shoe are at all times great, but particularly so in horses used for the cavalry and for hunting, it appeared a great improvement to apply a shoe which would be more firmly united to the hoof than any other shoe hitherto employed, and therefore productive of the best effects in all feet that require much iron and small nails. This shoe can be applied with proper effect by the most ignorant smith, as the simple difference from all other shoes consists merely in the inner and posterior part of both heels of the shoe being turned up so as to touch the inner and posterior part of both bars, by which means the heels of the hoof cannot contract, or the shoe have the smallest degree of lateral motion. The length of the turn up of the shoe is not very material, but it should be sufficiently long to embrace the heel of the bar, and yet not to touch the bottom of the cavity between the bar and frog. A bar-shoe may also be applied with a similar projection, to press against the heels of the bars. If the hoof is already contracted, the heels may be mechanically expanded a little by a pair of farrier's tongs every time the horse is shod, and the shoe applied so as to press with more force against the bars; but under these circumstances the hoof should first be made moist by standing two or three hours in water, and the horse not used for a day or two afterwards. In witness whereof, &c.

Description of a Mortar for preparing Mercurial Ointment.

By Mr. JAMES PHENIX, of Liverpool.

Communicated in a Letter to the Editors.

GENTLEMEN,

SEVERAL processes for making *Unguentum Hydragyri* having been proposed, but which are in general too complicated, the annexed sketch exhibits a mortar for that purpose, which unites simplicity with dispatch.

Fig. 6 (Plate XII.) is a front view of the mortar complete. A is a half section of the mortar; shewing how it should be cut, with a cavity at the bottom for holding the mercury, which by the friction is worked out and in till perfectly oxyded. B B is the pestle, with a wheel (C) in the middle, and two cross bars of iron loaded with lead at the extremities D D, to increase the rapidity of the movement. E, the cramp for fastening the whole together. F F, two uprights to support the handle G in working. G the handle, with an endless screw to turn the wheel C.

I am, Gentlemen, yours, &c.

JAMES PHENIX.

Improvements on Wheel Carriages.

By Mr. P. ANDREWS.

Communicated in a Letter to the Editors.

With Engravings.

Fig. 7 (Plate XII.) is a ground plan of a waggon, or other four-wheeled carriage. 1 is a pole; 2 2 are two splinter-bars; 3 3 are two chains attached to the extremities of both axle-trees by means of hooks or eyes, whose

Fig. 8.

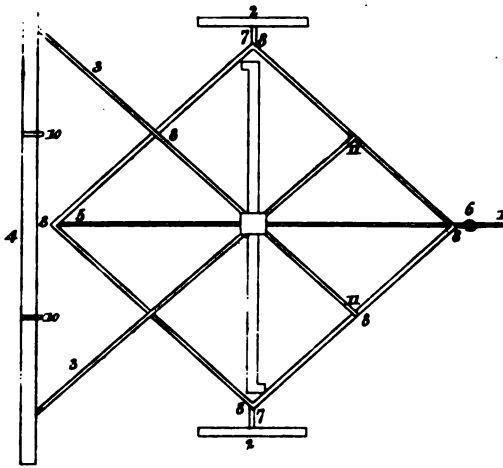


Fig. 7.

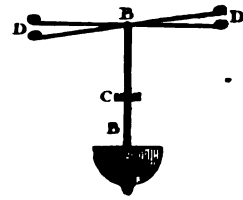
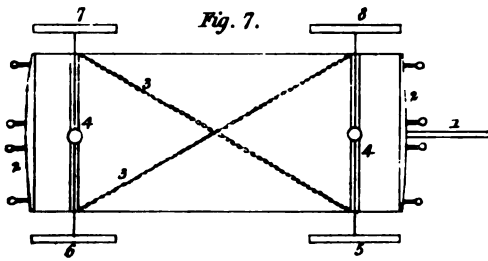
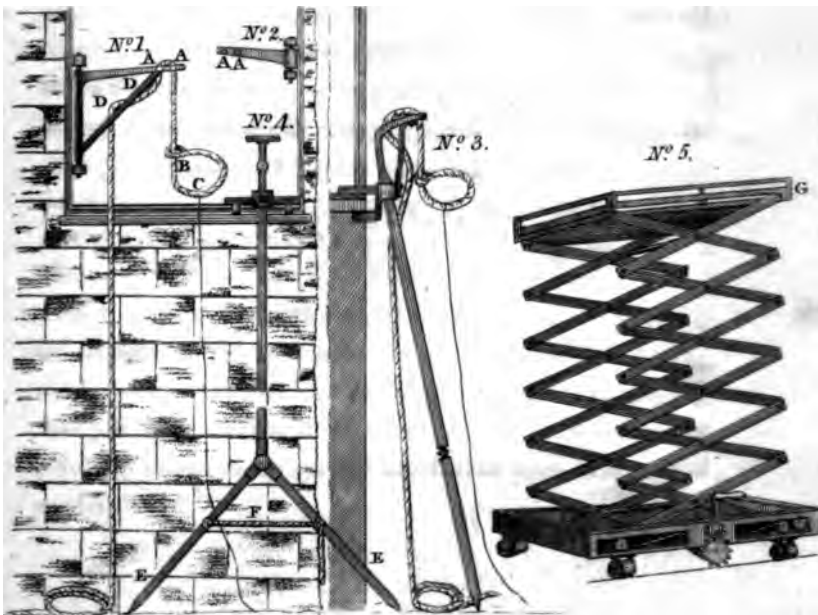
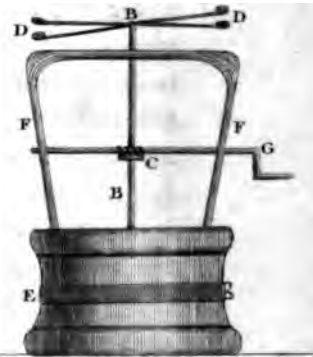


Fig. 6.



1

2

3

4

5

6

7

8

whose shanks or stems pierce the axle-trees, and are screwed tight by nuts at pleasure; 4 4 are the axle-trees; 5, 6, 7, 8, are the wheels. The two axle-trees revolve on centre bolts in the same manner that the fore axle-tree does in all four wheeled carriages; the chains 3 3 are fixed diagonally from 5 to 7 and 6 to 8, and take off all the strain or force from the centre-bolts. The chains are so placed, that the one is the whole width of the axle-trees above the other, therefore do not touch each other, and the parts of the chains are always comparatively at rest amongst themselves, consequently take off all friction. As the chains take off all strain or force from the axle-trees, those parts may be made much slighter, and the whole fabric of the waggon much lighter. The wheels may be made of any height, either to pass under the waggon or to look into a nook in the side. They should be cylindrical; and the fore axle-tree, if those wheels pass under, should be shorter than the hind axle-tree by the breadth of the fellyes; or if the fore wheels look into the side then that axle-tree should be so much wider; by this method the wheels would have different tracts, and be of great service to the roads, as they would cover twice their own breadth on the fellyes, and operate as rollers. From the position and effect of the chains the centre of gravity, of motion, and of draught, is in the same point, consequently (if the wheels are of the same height which they should be) the line of draught will be horizontal, and in every possible position a straight line; therefore such a carriage cannot be overturned unless it should be drawn on any bank, &c. whose elevation shall exceed forty-five degrees, and will run much lighter, and with less force, than any other carriage.

carriage. It will describe a circle round a point, therefore may be turned round on its own length of ground, and in a sharper angle than any other carriage can. Either end may be used as the fore end at pleasure, by merely shifting the pole or shafts, therefore all obstructions and stoppages are avoided. This carriage is admirably calculated for timber, as the line of draught is straight forward in all positions; the timber will be carried forward nearly half its length in the act of turning any angle, therefore such timber may be turned on this carriage where no other can. It is also well adapted for the conveyance of siege artillery or pontoons, as in case of necessity (which often occurs abroad, where such carriages, &c. must be long delayed, or perhaps abandoned to the enemy), the pole or shafts may be shifted in one minute, and the carriage retreat in safety.

Fig. 8 is the ground plan of an expanding axle-tree, adapted to various purposes in agriculture. 1 is the pole; 2 the wheels; 3 3 two bars of wood that cross the square frame, and extend and join to 4, which is a harrow, rake, or drill, with two joints 10, 10, which move both ways, so that when the carriage is in use the harrow, &c. not only expands with the carriage, but will let its ends fall downwards, so as completely to embrace any ridge of land however convex; also when the carriage is contracted, those arms and joints will cause and permit the harrow to contract at the same time. 5 is a chain or rope which is attached to the square frame at the point or angle next to 5, and extends under the axle-tree to 6, where there is a ring fixed to the said chain or rope. 6 is another ring fixed to the point or angle at 6. By fixing the horse to the ring of the rope
or

or chain, the carriage will with great ease be progressively expanded for use, and kept in that state. By fixing the horse on the ring 6, the carriage will in like manner be contracted, and kept so. Any other width may be had by a bar from 11 to 11. The square frame is composed of four pieces of wood, of such a length as to admit of an expansion of the intended width; they are fixed to each other by a bolt at all the angles marked 8, as are the two bars marked 3 3; so that every point of contact has a free motion. The whole frame is fixed to the axle-tree at 7, 7.

By this frame, &c. the carriage may be expanded or contracted with ease and at pleasure to answer any road, or to cultivate any given width of ground at once going over. The driver is to ride, and the horses and wheels to go in the furrows; thus do much more work, and in a better manner, with less injury to the soil and grain than by any method now in use.

This invention may be applied to a one horse chaise, taxed cart, &c. where the roads are bad, as such chaise, &c. could contract or expand so as to run within or without the old ruts; for which purpose the frame might be made circular, which would be a more pleasing form, and as slight as possible.

I am, Gentlemen,

Yours, &c.

P. ANDREWS.

Description.

Description of an Apparatus to secure Persons from sinking in Water, or to act as a Life Preserver when shipwrecked. By Mr. F. C. DANIEL, of Wapping.

With an Engraving.

From the TRANSACTIONS of the SOCIETY for the Encouragement of ARTS, MANUFACTURES, and COMMERCE.

The Gold Medal of the Society was voted to Mr. DANIEL for this Invention.

A, Fig. 2 (Plate XIII.) represents the body of the machine, which is double throughout, made of pliable water-proof leather, large enough to admit its encircling the body of the wearer, whose head is to pass betwixt the two fixed straps, B B, which rest upon the shoulders; the arms of the wearer pass through the spaces on the outside of the straps; one on each side, admitting the machine under them to encircle the body like a large hollow belt; the strap, C, on the lower part of the machine, is attached to the back of it, and by passing betwixt the thighs of the wearer, and buckling at D, holds the machine sufficiently firm to the body, without too much pressure under the arms. The machine being thus fixed, is inflated with air by the wearer blowing in from his lungs through the cock E, a sufficient quantity of air to fill the machine, which air is retained by turning the stop-cock. The machine, when filled with air, will displace a sufficient quantity of water to prevent four persons from sinking under water.

Mr. Daniel recommends his life preservers to be prepared as follows: viz. To select sound German horse-hides, and to cut a piece six feet long, and two feet six inches wide, free from blemish or shell; it is first to be curried, and then rendered water-proof by Mollerstein's

stein's patent varnish, of Osborn-street, Whitechapel, which preserves the leather more supple, and admits it to be easier inflated than any other water-proof leather*.

The leather is nailed on a board, and the varnish applied upon it; it is then to be passed into an oven several times, the varnish being each time repeated, till the leather is completely covered; it is then cut out in the form of a jacket, as above described, and neatly and firmly stitched; the seams and stitches are afterwards to be perfectly secured by the following black elastic varnish.

R.—Gum asphaltum, two pounds; amber, half a pound; gum benzoin, six ounces; linseed-oil, two pounds; spirits of turpentine, eight pounds; and lamp-black, half a pound; united together in an earthen vessel with a gentle heat.

The machine, when properly made according to the drawing and description, resembles a broad belt, or circular girdle, composed of two folds of pliable leather attached together, and perfectly impervious to water. When used, the wearer introduces his head and arms within the circle, the stop-cock in front, the two fixed straps E E rest one upon each shoulder, to prevent the belt from sinking down; the lower strap C, is then brought between the thighs, and buckled in front, which prevents the machine from being forced back; the machine is then inflated by the application of the mouth to the stop-cock in front, and when properly filled, the turning of the cock retains the air in the machine, and expands it so much as to displace a quantity of water so great, as to sustain the wearer, and a further weight, if necessary, buoyant in the water.

* See the specification inserted in the seventh volume of the present series, page 165.

The following Letters in Commendation of the Life Preserver have been received by Mr. DANIEL.

Copy of a Letter from Mr. GEORGE WILLERS, late Surgeon of the Alert Private Ship of War, lost off the Western Islands,

Sir,

I am happy in having it in my power to say, I owe my life to your invaluable invention, the life preserver; and the circumstances relative thereto are as follow:— I shipped as surgeon on board the Alert private ship of war, mounting 18 guns, and 98 men, commanded by James Desormeaux, esq. belonging to Messrs. Wright and Birch, Walbrook. We sailed for Falmouth, April 1805, and, after cruising five months, on the 22d of September we unfortunately struck on a rock in the Western Islands, and the ship went to pieces in five minutes; at that time we had eighty-four men on board: I witnessed the loss of every officer, six in number, and sixty-four foremast men; thirteen of the crew were saved, by clinging to pieces of the wreck, spars, &c. which drifted from the wreck; and I have the happiness to say, by possessing one of your life preservers (though I cannot swim,) I was supported for some time, the sea running mountains high, but providentially a large Portuguese boat put off to my assistance, being then near a mile from the shore; and I was thus saved by the hands of Providence, and your invention, from a watery grave.

I beg, Sir, you will permit me to acknowledge how much I feel myself obliged to you; and you are at full liberty to make this case known for the benefit of mankind.

I am, Sir, your most obedient servant,

G. H. WILLERS.

Sir,

Sir,

Mr. George Willers, late surgeon of the Alert private ship of war, and whom I succeeded as a surgeon in Mansion House-row, Kennington, in April 1807, went, as I have been informed, again to sea some time in the month of July or August following.

I have in my possession an engagement wrote by Mr. Willers, and which I have compared with the letter sent to Mr. Daniel, of Wapping, by him, giving an account of his happy escape from drowning, by means of his life-preserver; and I have no hesitation in saying, that the letter is in Mr. Willers's hand-writing, so far as comparison will guide me, having seen him *write* and *sign* the engagement above mentioned.

I have the honour to be, &c. &c. HUGH BROWN.

*Copy of a Letter from JOHN DICKENSON, Esq. of the
City of Norwich, to Mr. DANIEL.*

Sir,

I intended myself the pleasure of calling on you, and acquainting you personally of a singular incident, when the excellence of your machine, or life-preserver, was most conspicuously manifested.

I went from the city of Norwich, in a pleasure-boat that I keep for the amusement of sailing, in company with a gentleman and two ladies. As our return to Norwich, in the evening, was indispensable, and the direction of the wind favouring us both ways, a few hours would effect it, the distance being only thirty miles; accordingly we set sail about four o'clock, it being moon-light during the night; and fortunately procured, in case of accident (the wind blowing hard at South-east) one of your life-preservers, through the interest of a friend, of a captain, who had purchased one at Newcastle. The precaution proved, in a short time

after sailing, to have been a fortunate one indeed. On tacking to enter Norwich river, at the extremity of a broad water, two miles over, known by the name of Braydon, a sudden gust overset the boat, precipitating myself, companion, and two ladies, into as agitated a water as I have ever seen at sea, (except in hard blowing weather). You may judge my situation at such a juncture. Your machine was jokingly filled as we came along, to which I ascribe (though very unexpected by us) our preservation. The gentleman, whose name is Goring, was inexpert at swimming, and with difficulty kept himself up, till I reached him; and then directing him to lay hold of the collar of my coat, over which the machine was fixed, I proceeded towards the ladies, whose clothes kept them buoyant, but in a state of fainting when I reached them: then taking one of the ladies under each arm, with Mr. Goring hanging from the collar of the coat, the violence of the wind drifted us on shore upon Burgh Marshes, where the boat had already been thrown, with what belonged to her. We got the assistance of some countrymen directly, (after taking refreshment at a marsh farmer's house, where we procured some dry clothing for the ladies, who were now pretty well recovered,) and by their endeavours put the boat in sailing trim, and prosecuted our voyage to Norwich, which we effected by eleven o'clock that night.

From this singular escape, on my return from Birmingham, I shall be induced to inspect your warehouse, and procure the various prices of your invention, anxious to recommend it in even sailing excursions, in which its utility has been so evidently demonstrated, and its use ascertained.

Your most obedient humble Servant,

JOHN DICKENSON.

Account



Fig. 6.



Fig. 7.

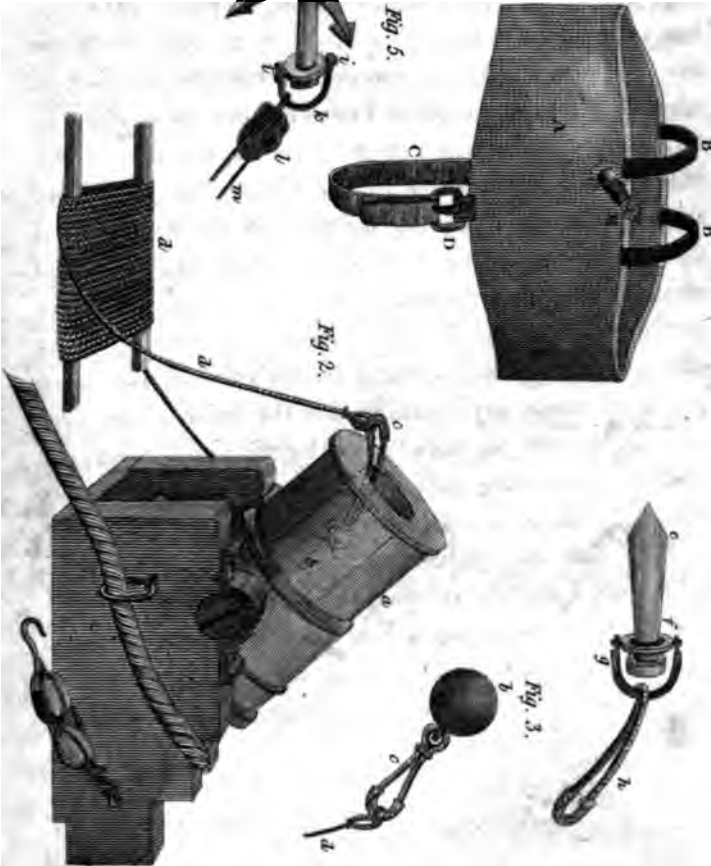


Fig. 1.

Fig. 4.

Fig. 3.

Fig. 2.

Fig. 5.

Account of a Method of throwing a Rope on Shore by Means of a Shell from a Mortar on-board the Vessel in Distress. By Lieutenant JOHN BELL, of the Royal Artillery.

With Engravings.

From the TRANSACTIONS of the SOCIETY for the Encouragement of ARTS, MANUFACTURES, and COMMERCE.

In consequence of the Publicity which has lately been given to some similar Experiments, the Society have published the following Account of a Method of relieving a Vessel in distress, for which they rewarded Lieutenant BELL with Fifty Guineas, so long back as 1792.

SEVERAL trials were made before a Committee of the Society at Woolwich, on the 29th of August 1791, of throwing a line on shore according to Lieutenant Bell's principle, which were as follow.

From a boat moored about 250 yards from shore, the shell was thrown 150 yards on shore, with the rope attached to it; the shell was of cast-iron, filled with lead, it weighed 75 pounds, its diameter eight inches; the rope in the trial was a deep sea-line, of which 160 yards weighed 18 lbs.; the angle of the mortar from whence the shell was fired, was 45 degrees. By means of the line, Mr. Bell and another man worked themselves on shore upon his raft of casks; there were many kinks in the rope, which were with ease cleared by Mr. Bell, in which he was much assisted by his snatch blocks.

The second trial was repeated in a similar manner, and with equal success, the shell falling within a few

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yards

years of the summer season, the gale of wind was brisk, and the water rough. The direction of the shell was nearly from North to South, and the wind blew nearly North-east.

In the third trial, the mortar was elevated to 70 degrees; the rope attached to the shell was an inch and half twisted rope, of which every 50 yards weighed fourteen pounds and a half. the shell of the kind above-mentioned. it fell 150 yards from the mortar, and burst itself about two-thirds in the ground; the line or rope run out was about 100 yards, and it required the force of three men to draw the shell out of the ground at that distance.

The grammaut, in all these trials, was of white three-inch rope; and in all the above trials, by means of the line, two men worked themselves on shore upon the raft: each charge of powder was fifteen ounces.

A fourth experiment was made by firing, from the same mortar, a grapnel in a wooden case; it did not retain its hold in the ground so well as the shell, but amongst the crevices of rocks, or where the vessel is near shore, will be useful.

A grapnel of this kind may be fired from a common cannon with an endless rope, running in a pulley or small block fixed thereto, by which a raft may be successively drawn to and from the vessel either by the persons on-board the vessel, or those on shore.

Observations made by Lieutenant BELL, upon throwing a Line on Shore in case of a Ship being stranded.

1st. From the proposed construction of the piece of ordnance, intended to throw the shot and line on shore,

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I suppose it will be between five and six hundred weight.

The chamber is to contain one pound of powder, and the bore to admit a leaden ball of sixty pounds or upwards; the length of range, or distance, will depend upon the size of the line made use of; I suppose it will carry a deep sea-line between three and four hundred yards distance.

2d. All ships that have iron ballast, may use this piece as a part of it, and then there will be only the trifling difference of casting so much of the ballast into the form of the piece; the leaden balls may likewise be used as ballast.

3d. I am of opinion there are various ways, on-board of a ship, that the mortar may be placed in a proper position for firing without a carriage expressly made for it; it may be placed upon a coil of rope, or its trunnions rested upon coins, or any thing else, whereby the muzzle can be raised so high that the groove upon the trunnion appears vertical, as the piece in that position would be elevated nearly 45 degrees.

4th. As I imagine all ships carry deep sea-lines, on that account I made use of it in the experiments at Woolwich; but if it should be thought too short for the distance, any other light line may be added to the length of it.

5th. Supposing a ship's owner to purchase such a piece of ordnance with the leaden balls, and a block-carriage; I do not think the whole would amount to more than ten or eleven pounds expence.

6th. Where a ship is driving or unmanageable near the shore, it would be proper to have the piece loaded, the line reeled upon hand-spikes or poles, and laid upon the
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the deck ready for firing at any time it might be judged necessary. The hand-spikes or poles the line is reeled upon preserve it in an horizontal form; and they are not to be drawn out until the instant of firing: in this manner the line will deliver itself freely.

The five water-casks should also be prepared in readiness, by lashing them together, and a seamen's chest fixed upon the top of them, having part of its ends or sides cut out in order to let out such water as may be thrown into it by the surf. I dare undertake to land with such a float upon a lee-shore any where upon the coast, when it might be deemed unsafe for a boat to make good its landing.

7th. There is every reason to conclude, that this contrivance would be very useful at all ports of difficult access both at home and abroad, where ships are liable to strike ground before they enter the harbour, as Shields Bar, and other similar situations, when a line might be thrown over the ship, which might probably be the means of saving both lives and property; and moreover, if a ship, was driven on shore near such a place, the apparatus might easily be removed to afford assistance; and the whole performance is so exceedingly simple, that any person once seeing it done, would not want any farther instructions.

JOHN BELL.

Some farther Observations made by Lieutenant BELL, upon the Application of the Mortars intended for throwing a Line on Shore, in case of a Ship being stranded.

1st. In trading ships, this piece would answer for making signals of distress, by filling the chamber with powder, and well wadding it, as the report would be heard some miles distance at sea.

2d. Such

2d. Such a gun, being accompanied with a few rounds of round and grape shot, would defend a ship much better than a longer gun, against any piratical or other hostile intentions, as, from its shortness, it would be more readily loaded and fired with a larger charge each time.

3d. Accidents from a gun bursting, which may arise from an unskilful person loading with too great a proportion of powder, is in this piece effectually guarded against, by the chamber being constructed to contain but one pound of powder, a quantity which is only about one-third of the usual charge of a cannon.

4th. From the small size of such a gun and carriage, it might be kept upon deck, without much inconvenience in working the ship, in order to be ready if necessity required; and when the ship is out at sea, it might then be put below. But from the number of dreadful wrecks, which so frequently happen along the coast, it certainly would be prudent to have it always upon deck when within sight of land, and particularly in stormy weather.

JOHN BELL,

Reference to the Engraving of Lieutenant BELL'S Method of throwing a Rope on Shore from a stranded Vessel, Plate XIII. Fig. 2.

a, represents the mortar on its carriage; *b*, the shell shown within the mortar by dotted lines; *c*, the grommet, or double rope, which connects the shell and line; *d d*, the line to be thrown on shore, now ready wound on the poles or handspikes, *p p*, and which are to be withdrawn when the mortar is fired.

Fig. 3 is a separate view of the shell, with the grommet and end of the line attached thereto, explained by the same letters.

Fig.

Fig. 4 shews another invention, suggested instead of a shell, and to be fired from a common cannon, in which *c* is an iron pin; *f*, an iron collar and rope sliding upon it; *g*, an iron ring which turns upon two pins in the collar; *h* is the grommet or double rope attached to the ring, to which the line to be thrown on shore is fastened. This plan may be used where people are on shore, to assist when a line is thrown.

Fig. 5 shews a grapnel which may also be fired from a common cannon; the collar slides along it in the same manner as that in Fig. 4, to allow the head of the pin to go down to the wadding within the cannon; *i i*, are two pins on which the ring *k* is moveable; *l*, the block or pulley fastened to the ring; *m*, the endless or double line running through it.

This method may be used with great advantage, where a ship is stranded near the shore; but where a mortar is on board, the use of the shell and line is the most certain.

Fig. 6 shews the method of forming a raft, by lashing together with ropes five empty water-casks belonging to the ship.

Fig. 7 represents the raft ready for use; the apparatus *n* to hold the person upon it, is made from a seaman's chest with holes cut in the sides of it, to allow the person within it firmer hold, and to let out the water that may be thrown into it from the waves; *o o* are two pulleys attached to the ends of the chest, and through which the line is to run; the raft is to be ballasted underneath, to prevent it from upsetting.

The whole apparatus is so arranged as to be inclosed in a small box, as may be seen by a reference to that in the Society's possession.

*On the Use of Tar for Cattle swelled by eating Clover,
and on Opium and other Preparations from Poppies.*

*By Major SPENCER COCHRANE, of Muirfield House, near
Haddington, North Britain.*

From the TRANSACTIONS of the SOCIETY for the Encouragement of ARTS, MANUFACTURES, and COMMERCE.

COWS are frequently seized with violent swellings from having been imprudently allowed to eat clover when wet. A gentleman recommended to me, as a cure, an egg-shell full of tar, immediately to be put down the creature's throat. In two instances of my own cattle I found it had the effect of laying the swelling in a few minutes. A neighbour of mine whose cow was supposed could not live five minutes, was, on application of the tar, unexpectedly recovered, to the great joy of the poor man.

After I commenced farmer, I unfortunately lost four horses, by a disorder, very frequent in this country, called the *bats* or *gripes*; some of them died in a few hours, and none of them were ill more than two days. For some years past I have given my horses in such cases a table-spoonful of tincture of opium, or liquid laudanum, and have since lost none. If the first dose given in some liquid does not allay the violent pain and swelling, I administer a second spoonful, which I have hitherto, in all cases, found to have the desired effect, and generally in a very short time.

If I find the horse very hot and feverish, and sweating profusely, as is usually the case in this disease, I

order him to be bled plentifully, and an ounce or more of nitre to be mixed, and administered with the laudanum, keeping the horse warm, and letting him be well rubbed round the belly.

A very considerable farmer near me, who has had a medical education, told me, a few days ago, that he had not lost a horse since he gave them laudanum.

Ten days ago I was equally fortunate in a trial of it on one of my sheep, which, half an hour after being washed with the rest of the flock, was taken so extremely ill, and swelled so much, that my herdsman supposed she could not live, having lost some of his own, which had apparently been in the same state. I immediately ordered half a handful of common salt to be dissolved in half an English pint of warm water, into which I put sixty drops of the laudanum, and poured it with difficulty down the animal's throat, which seemed nearly dead. For the first five minutes I had so little hopes of the sheep's recovery, that I ordered the man to get his knife ready to cut her throat; whilst he sharpened the instrument for such purpose, he observed the animal to move its jaw to a proper position, which had previously been much distorted; the eyes then began to quicken, and apparently to become at ease. In half an hour afterwards the sheep got on her legs, and remained standing for some time; a plentiful evacuation soon took place, the swelling subsided, she continued to recover, and in a few hours from the first attack began to eat and do well.

My intent in these communications is to render generally public what I have found so very beneficial. At this time, when horses and cattle are so extremely high
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in price, every thing that can tend to preserve their lives, should be made known and put to trial.

I formerly noticed to you, that I had tried on a small scale, for several years; the culture of white poppies to prepare opium from them, and an extract or syrup of poppies; that I had raised a sufficient supply for myself and friends, and that my extract was equal in effect to any prepared from foreign opium. I recommend the poppy seeds to be sown in March, in drills.

Besides the advantages from the poppy heads as a medicine, the seeds yield a valuable oil. Two pounds of the seeds furnish by expression seven ounces of a pure bland oil, useful for portrait painting and other purposes. It has been proved in Holland to be equal in quality to fine sallad or olive oil, and it would probably be advantageous to propagate largely so valuable a plant.

Since my former communication I have had frequent opportunities of being fully convinced of the efficacy of laudanum, when applied in proper time, for the cure of the cholic in horses. When inflammation has taken place, which sometimes comes on very rapidly, its application will be too late. A few days since two of my draught horses were taken ill, one in the morning, the other in the evening. I believe the disorder originated from their having been allowed to drink too much water when warm. By using the laudanum in the manner I have recommended they both recovered, and were at their work again within twenty-four hours. I grow the

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poppy, extract the opium from the heads, infuse it in spirits or brandy agreeably to the prescription in the Dispensatory, and thus prepare the laudanum myself, instead of purchasing it at the apothecary's. I consider my opium to be pure and unadulterated, and of course stronger, and more efficacious.

I have cured many persons of colds and coughs of long standing, by the following preparation or syrup.

Take half a pound of the heads of the large white poppy without any of the seeds, the heads just ripe and moderately dried, put them into three quarts of boiling water, let them boil gently, till the liquor is reduced to one quart, squeeze the poppies well in a cloth to strain out the liquor, boil the liquor again slowly to one pint and strain it, then add to it a pint of white wine vinegar, and one pound of raw sugar, let them boil gently to the consistence of a syrup, then add thereto spirit or elixir of vitriol to make it gratefully acid. The dose I have recommended for adults is one or two tea-spoonfuls, but never exceeding three, on going to bed. If the cough continues violent, two more may be taken the following morning. One dose sometimes cures, two generally, and I have never had occasion to employ it more than thrice. For young children one tea-spoonful is sufficient.

I recommended the use of this medicine to a surgeon in Haddington, and he told me it answered beyond his expectation.

*An Account of the Method of cultivating the American
Cranberry (Vaccinium Macrocarpum), at Spring Grove.*

By the Right Hon. Sir JOSEPH BANKS, Bart.

K. B. P. R. S. &c.

From the TRANSACTIONS of the HORTICULTURAL
SOCIETY of LONDON.

THE American Cranberry, the *vaccinium macrocarpum*, has for some years been cultivated with success at *Spring Grove*, and as the fruit of it is now become an object of some importance in the economy of the family, a short account of the management of this unimproved plant will, it is to be hoped, prove acceptable to the Members of this useful Society, and not uninteresting to the public at large.

For the better understanding the intended communication it is necessary to premise, that a spring rises in a small grove within the precincts of *Spring Grove*, which is no doubt the origin of the name; this spring is carried in leaden pipes into the house, to which it affords an ample supply; the waste water is suffered to run through a small basin and a pond in the pleasure ground, before it escapes to *Smallbury Green*; to this constant supply of fresh water, though it is very small, the great luxuriance with which water plants of all kinds suitable to this climate, succeed in the pond, is no doubt in some degree to be attributed.

In the middle of the basin, a small island has been formed, by supporting a box of oak upon posts driven into the bottom; in the centre of this pond, the waste water which used before to issue through a fountain, is suffered

suffered to flow in the form of a spring, which rising into a large shell of the *chama gigas*, perforated for the purpose, imitates very well a natural spring, and gives in hot weather an appearance of freshness and coolness, very pleasant to those who walk in the garden.

The oak box, which constitutes this artificial island, is circular, 22 feet in diameter, and 13 inches deep; the bottom is 5 inches under the surface of the water, and bored through with many holes; on this a layer of stones and rubbish was first placed, and upon that a covering of bog earth, brought from *Hounslow Heath*, which together are 5 inches below and 7 inches above the surface of the water of the basin; in this bed of black mould, a variety of curious bog plants were placed about 7 years ago, which flourished in an unusual degree, among these was the *vaccinium*, which flowered and ripened its fruit the first year.

In the autumn of the second year it again produced a plentiful crop, and soon after began to send out runners somewhat resembling those of a *strawberry*, but longer and rather less inclined to take root while young; they did however take root in the winter, and early in the spring threw out upright branches 10 inches and a foot long, on which the flowers and fruits were chiefly placed; the produce was this year gathered, and found to be high flavoured berries, very superior to those imported, which have in general been gathered unripe, and have become vapid and almost tasteless by long soaking in the water in which they are packed for carriage.

It was now determined to consider the *American cranberry* as an article of kitchen garden culture, and to give up the whole of the island to it, which in a few years

years it entirely covered by its own runners, without any fresh plants being put in, and this bed, with the addition of some hanging boxes receding from the centre to the sides, produced, in the year 1806, 23 bottles of very fine *cranberries*.

In the year 1805, a bed was made on the side of the pond 20 feet long and $5\frac{1}{2}$ feet broad, by a few stakes driven into the bottom parallel to the side, and lined with old boards; the bottom of this was filled up with stones and rubbish, and on these a bed of black mould, 3 inches above and 7 inches below the usual surface of the water, was laid: this was planted with *cranberry* plants, many of them having been rooted in a hot-bed, in which they thrive most vigorously. In this autumn, 1807, the bed produced a crop which, added to that of the island, afforded a supply for the family, of 5 dozen bottles of *cranberries* besides a small basket reserved for present use. The total contents of the two *cranberry* beds, is 326 square feet; the quantity of land employed for raising *strawberries* at *Spring Grove*, is, after the divisions between the beds have been deducted, 5645 square feet; the beds necessary to give a sufficient supply of *cranberries* for the family, did not therefore occupy quite one-eighth of the space allotted to *strawberries*.

The Society will, I hope, forgive this detail of the origin and progress of this kind of cultivation: successful as it has been, it must still be considered in its infancy, and not sufficiently established to afford general rules for the regulation of a gardener's proceedings: it originated entirely in a fortunate accident, the history of which, will, it is hoped, give an adequate idea of the method now practised, and at the same time bear testimony

mony in favour of the opinion, that more benefit has been derived in the advancement of Horticultural knowledge, by pursuing the hints which Nature continually gives, than from the effects of abstract reasoning and original invention.

It is remarkable that, during the seven years these *cranberries* have been cultivated at *Spring Grove*, no circumstance has arisen, from the variety of seasons, from blight, or any other circumstance, that has diminished the quantity of a full crop; the flowers have issued out of their buds, in abundance, in their due season, and fewer of them have been abortive, than in general is the case in other plants. The fruit has gradually swelled and duly ripened without being subject to the attack of any vermin, or to injuries of any kind from the excesses of heat or cold, or from those of wetness or of drought.

Observations on the Means of giving to the Wheels of heavy Carriages the same Intensity of Pressure on the Surface of Roads; and a Statement of the Advantages that would result therefrom.

By ALEXANDER CUMMING, Esquire, of Pentonville.

(From the APPENDIX to the REPORTS of the COMMITTEE of the HOUSE OF COMMONS on the Highways of the Kingdom.)

1. **ADMITTING** that the cylindrical wheel was universally adopted, it becomes of the greatest importance that the breadth of the wheels be adjusted to the weight of the load; so that the *track or impression of the wheels of every carriage* shall be of the same depth, and that
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the wheels of each carriage may reciprocally roll in or upon the tracks of each other without damage ; but that on the contrary each subsequent wheel shall add to the improvement of the preceding, and render the track more perfect than before.

2. There appears to have been a great oversight in the regulations of the 13th of Geo. III. in this respect. The weight of the loaded waggon being divided into four, and each wheel supposed to bear an equal share, the total pressure of the wheels on the road appears to have been taken as the *effective power* of the wheel to act and make an impression on the surface ; and no other criterion of the intensity of that power to cut the surface, or to make an impression or rut was assumed ; no notice appears to have been taken of the proportion which the breadth of the wheel had to the weight that it sustained ; nor of the *intensity* of the action of the same weight on wheels of different breadths.

3. By this manner of estimating the effective power, or the intensity of the force, with which the wheel compresses the surface which it rolls, one should be led to many erroneous conclusions ; the intensity of the pressure of the wheel would always be supposed to depend wholly on the weight of the load, whatever might be the breadth of the wheel ; and by that rule, the intensity of action of the 16-inch wheel with the load of eight ton would be to the intensity of the wheel of three inches, and the load of $3\frac{1}{2}$ ton, as 4,480 to 1,960 ; and this would seem a pretty fair proportion between the weight of the load and the breadth of the wheels, at least it is so fair in appearance, that the heaviest load has the greatest intensity.

4. Nothing can be more certain than that increasing the breadth of the wheel diffuses the pressure on a larger surface, and diminishes the intensity of that pressure on every inch of the surface that is rolled; let us then examine and compare the intensity of pressure of the 16-inch wheel, and the three-inch wheel, with the loads as before, making allowance for the breadth of each of the wheels; and the intensity of the pressure on *every inch* that is rolled by the 16-inch wheel with the load of eight ton, will be equal only to the dead weight of 280 lb. The intensity of the pressure of the three-inch wheel with the load of $3\frac{1}{2}$ ton is equal to 653 lb., which is considerably more than twice the intensity of the pressure with the 16-inch wheel. This shews how little attention has been paid to the real advantages of the broad wheel, and the disadvantages of the narrow; and proves the necessity of such new regulations, as shall render the intensity of the pressure of all wheels, and with different loads, on the surface of the roads, equal to each other, so that every wheel shall make an impression or track of the same depth.

5. The following table is according to the 13th of Geo. III. The three first columns give the breadth of the wheels, the weight of the load, and the number of horses, as stated in that Act; the fourth column gives the weight drawn by each horse; the fifth gives the weight on each wheel, or the total pressure, whatever be the breadth of the wheel; and the sixth column gives the pressure on every inch of the breadth of the wheel, or the true intensity of the pressure on the surface of the road, according to the breadth of each wheel.

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Breadth of the Wheels.	Weight of the Load.	The Number of Horses.	Weight drawn by each Horse.	Weight on each Wheel	Pressure on every Inch.
16 Inches.	8 ton.	10	16 cwt.	40 cwt.	280 lb.
9 do. rolling 16	6½ ton.	8	16 do. 42lb.	32 cwt.	404 lb.
9 do. rolling 9	6 ton.	8	15 do.	30 cwt.	373 lb.
6 do. rolling 11	5½ ton.	6	18 do. 37lb.	27½ cwt.	513 lb.
6 do. rolling 6	4½ ton.	6	16 do.	22½ cwt.	420 lb.
3 do. rolling 3	3½ ton.	4	17 do. 56lb.	17½ cwt.	653 lb.

7. It appears by this table that no regular proportion has been observed between the breadth of the wheels, the weight of the load and the number of horses; in the fifth column the *sum* of the pressure on the wheel decreases pretty gradually as the wheels become narrower; but in the sixth column, where the breadth of the wheel is taken into the account, the intensity of the pressure on every inch of the surface that is rolled, is increased as the wheels become narrower, which seems contrary to all reason.

8. With the nine-inch and the six-inch wheels, when they roll a double surface, the weight of the load is considerably increased, although the resistance to the progress of the wheels, and the labour of the cattle, with the same load, is increased by rolling the double surface.

9. If the roads be in good order, the double rolling is of no use; if they be soft and compressible, the resistance becomes greater, as the surface that is rolled is broader; and it is generally supposed, that the resistance in rolling the double surface is the same as with the single; but it ought to be remembered that with the single surface the hind wheels run in the paved track of

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the front wheels, but with the double surface every wheel has to compress and level its own track.

10. It is much better to increase the breadth of the cylindrical wheels, than to make the front and hind wheels of the same carriage to roll double surfaces; the intensity of pressure on the surface of the road is diminished by increasing the breadth of the wheels, but not by rolling a double surface.

11. The advantages of rendering the intensity of the pressure of the wheels of all carriages as nearly equal as may be practicable, would be of the next greatest importance to the introduction of the cylindrical wheel.

12. Let us suppose a three inch wheel under a load of $3\frac{1}{2}$ ton running in the track made by a 16-inch wheel with the load of eight ton; the intensity of the narrow wheel 650 lb.; that of the broad wheel, in whose track it runs, is only 280 lbs.; the narrow wheel will therefore cut up the bottom of the broad track, and meet with much more resistance than if it made no such impression; the resistance to the next wheel that follows in the same path is increased by the breaking up of the path; and the smooth surface of the broad track being cut open, it admits water, and introduces all the bad effects of wet seasons and subsequent hard frosts; all which evils might be avoided by having the intensity of the pressure of the narrow wheels only equal to, or something less than, that of the broad wheel; the narrow wheel would in that case roll with great facility in the path of the broad wheel, without making any impression, or in any respect damaging the track in which it runs.

13. And if all wheels were made of as equal intensity as circumstances will permit, they would mutually roll
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in the tracks of each other, without any other effect than each repairing the path of any accidental damage which it may have received since the last wheel passed, the road will become more and more consolidated, its surface more close and impervious to water; there will be no dragging or grinding of conical wheels, no means of converting the best material into dust in summer, or into sludge in winter; there will then remain no other cause of damage to the roads except the pedestrian exertion of cattle.

14. The intensity of the pressure of the wheels may be regulated by maintaining a regular proportion between the weight of the load and the breadth of the wheels; it is nevertheless adviseable to take the number of cattle into the account, and by that means it would seem that the intensity of the pressure might be preserved sufficiently equal with the cylindrical wheels, without the controul of the weighing-engine, by observing a regular proportion between the number of horses and the breadth of the wheels.

15. The following table, therefore, is so constructed as to give a regular proportion between the number of horses, the breadth of the wheels, and the weight of the load; and as two horses are the fewest that can be employed in a four-wheeled waggon, we begin with that number, and proceed regularly to eight; and taking the average of the weight drawn by each horse, according to the Act of the 13th of Geo. III. we find it 16 cwt.; and assuming that as the weight to be drawn by each horse, according to the new regulation also, the weight of the load is thus determined by the number of horses, allowing 16 cwt. to each; and the breadth of wheel that is allowed to each horse is determined by the sixteen-

23. But with the cylindrical wheel there is no dragging at the rim, no grinding or pulverising, no resistance but what arises from the compressing and consolidating the materials; all the additional weight of the load increases the compressive force on the same extent of surface, and improves the road on which it rolls; and although the labour of the cattle must be increased the first time of rolling a new track, in proportion as the load is heavier and the impression deeper, the consolidation becomes more perfect, and the improvement more permanent, and the road, instead of being damaged by increasing the weight of the load with the cylindrical wheels, is improved by it.

24. Where then is the use of the weighing engine, with the cylindrical wheels?—It is not easy to divest the mind of impressions that have already been made, and confirmed by long experience. It is very natural for the waggoner to say, “If adding to the weight of the load and to the breadth of the wheel, have heretofore been found by experience to be unfavourable to the roads, how happens it they should now become advantageous.”

25. The answer is simple and easy: the *broad wheels* formerly used were conical; and all the properties that arise from the conical shape are the most unfavourable to the roads that can be conceived; and so sensibly did the proprietors of broad-wheel waggons feel the bad effects of these broad wheels, that they have tried to avoid them, by narrowing the bearing of the wheels, conceiving that the only means of avoiding an evil that was increased with the breadth of the wheel, was, by reducing that breadth; and this introduced the convex sole, and the narrow middle tire, and with them all the destructive

destructive effects of narrow wheels carrying monstrous loads; under all which circumstances the nature of the conical shape left them only the choice of two great evils, those that are inseparable from the conical shape, and those that are peculiar to the narrow wheels, each of which are increased by adding to the weight of the load.

26. But every property of the cylindrical shape is of the most favourable nature possible to the roads, and to the labour of the cattle; and the additional pressure that was so destructive to the roads with the conical wheels is in an equal degree favourable with the cylindrical wheel; and if a discretionary liberty be given of loading every waggon that has its cylindrical wheels of a breadth proportioned to the number of horses, no disadvantage will arise to the roads from any weight which that number of horses can draw.

On Oxalic Acid.

By THOMAS THOMSON, *M. D. F. R. S. Ed.*

Communicated by CHARLES HATCHETT, *Esq. F. R. S.*

From the PHILOSOPHICAL TRANSACTIONS of the ROYAL
SOCIETY of LONDON.

OXALIC acid, from the united testimony of Ehrhart, Hermbstadt, and Westrumb, appears to have been discovered by Scheele; but it is to Bergman that we are indebted for the first account of its properties. He published his dissertation on it in 1776, and since that time very little has been added to the facts contained in his valuable treatise. Chemists have chiefly directed their

attention to the formation of that acid, and much curious and important information has resulted from the experiments of Hermstadt, Westrumb, Berthollet, Fourcroy, and Vauquelin, &c. but the properties of the acid itself, have been rather neglected. My object in the following pages is not to give a complete history of the properties of oxalic acid, but merely to state the result of a set of experiments, undertaken with the view of ascertaining different particulars respecting it, which I conceived to be of importance.

I. Water of Crystallisation.

Oxalic acid is usually obtained in transparent prismatic crystals more or less regular; these crystals contain a portion of water, for when moderately heated they effloresce, and lose a part of their weight, which they afterwards recover when left exposed in a moist place. When cautiously heated on a sand-bath they fall to powder, and lose about a third of their weight. But as the acid is itself volatile, it is not probable that the whole of this loss is water. To ascertain the quantity of water contained in these crystals I had recourse to the following method.

1. Seventy grains of crystallised oxalic acid were dissolved in 600 grains of water, constituting a solution which weighed 670 grains.

Fifty grains of pure carbonate of lime, in the state of calcareous spar, were dissolved in muriatic acid; this solution was evaporated to dryness to get rid of the excess of acid, and the residue redissolved in water.

Into this muriate of lime the solution of oxalic acid was dropped by little and little as long as any precipitate

tate fell, and the oxalate of lime thus formed was separated by the filter. Pure oxalic acid is not capable of precipitating the whole lime from solution of muriate of lime, the muriatic acid evolved being always sufficient to retain the last portions in solution.

It was necessary to get rid of this excess of acid; the method which appeared the least exceptionable was to saturate the muriatic acid with ammonia; accordingly, when the oxalic acid ceased to occasion any farther precipitate, I cautiously added pure ammonia, till the liquid ceased to produce any effect upon vegetable blues. A copious additional precipitate of oxalate of lime was thus obtained. Oxalic acid was now added again as long as it rendered the liquid muddy. By thus alternately having recourse to the acid solution, and to ammonia, and by adding both with great caution to avoid any excess, I succeeded in separating the whole of the lime without using any sensible excess of oxalic acid.

558 grains of the acid solution were employed, a quantity which is equivalent to 58.3 grains of the crystallised acid.

2. The oxalate of lime, after being well washed and drained, and exposed for a week to the open air, at a temperature of about 60°, weighed 76 grains; but upon being left on the sand bath for some hours in a temperature between 200° and 300°, its weight was reduced to 72 grains.

3. These 72 grains of dry oxalate of lime were put into an open platinum crucible, and gradually heated to redness. By these means they were reduced to 49.5 grains, which proved to be carbonate of lime. The crucible was now exposed to a violent heat in a forge. Nothing remained but a quantity of pure lime weighing 27 grains.

X x 2

4. From

4. From this experiment we learn, that 72 grains of dry oxalate of lime contain 27 grains of lime. Of consequence, the oxalic acid in this compound must be 45 grains. But the weight of crystallised oxalic acid actually used was 58.3 grains, a quantity which exceeds the whole acid in the oxalate by 13.3 grains. These 13.3 grains are the amount of the water of crystallisation, which either did not unite with the salt, or was driven off by the subsequent exposure to heat. Hence crystallised oxalic acid is composed of

Real acid	45.
Water	13.3
	58.3

Now this is equivalent to

Real acid	77
Water	23
	100

So that the crystals of oxalic acid contain very nearly the fourth part of their weight of water*.

II. *Alka-*

* Vauquelin in a late dissertation on cinchona, marked with that profound skill which characterizes all the productions of this illustrious chemist, has mentioned incidentally, that the crystals of oxalic acid contain about half their weight of water. He dissolved 100 parts of cinchonate of lime in water, and precipitated by means of oxalic acid; 22 parts of crystallised oxalic acid were necessary; and the oxalate of lime formed weighed 27 grains. From this experiment he draws the conclusion which I have stated, (*Sec Ann. de Chim. lix. 164.*) But this ingenious chemist does not seem to have been aware of the real composition of oxalate of lime; 27 grains of that salt are composed very nearly of 10 grains of lime and 17 grains of acid. But the weight of the crystals used by Vauquelin was 22; the difference, 5, is obviously the water of crystallisation in 22 grains of the crystals. But if 22 grains contain 5 of water, it is obvious, that

II. *Alkaline and Earthy Oxalates.*

1. The preceding experiment gives us likewise the composition of oxalate of lime. This salt, when merely dried in the open air, still retains a portion of water which may be driven off by artificial heat. It is necessary to know that it parts with this water with considerable difficulty, so that a long exposure on the sand or steam bath, is necessary to get it thoroughly dry. It afterwards imbibes a little water if it be left in a moist place. Well dried oxalate we have seen is a compound of

Acid	45 or per cent.	62.5 acid.
Base	27.....	37.5 base.
	72	100

Though the oxalate of lime dried spontaneously can scarcely be considered as always in the same state, yet as the difference in the portion of water which it retains is not great, provided it be dried slowly in the temperature of 60°, and in a dry place, it may be worth while to state its composition. It is as follows :

Acid	45 or per cent.	59.2 acid.
Base	27.....	35.5 base.
Water	4.....	5.3 water.
	76	100.0

When rapidly dried, as by pressing it between the folds of filtering paper, it is apt to concrete into hard lumps, which retain more moisture. In this state I have sometimes seen it retain 10 *per cent.* of water after it appeared dry.

100 contain very nearly 23. So that his experiment in reality coincides with mine.

Bergmann.

ing soluble superoxalates with this acid; but I have not tried the experiment. These oxalates, as well as oxalate of lime, are partially soluble in the strong acids.

4. Oxalate of magnesia is a soft white powder, bearing a considerable resemblance to oxalate of lime. It is tasteless, and not sensibly soluble in water; yet when oxalate of ammonia is mixed with sulphate of magnesia, no precipitate falls; but if the solution be heated and concentrated sufficiently, or if it be evaporated to dryness, and redissolved in water, in both cases the oxalate of magnesia separates in the state of an insoluble powder.

5. Oxalate of potash readily crystallises in flat rhomboids, commonly terminated by dihedral summits. The lateral edges of the prism are usually bevelled. The taste of this salt is cooling and bitter. At the temperature of 60° it dissolves in thrice its weight of water. When dried on the sand-bath, and afterwards exposed in a damp place, it absorbs a little moisture from the atmosphere.

This salt combines with an excess of acid, and forms a superoxalate, long known by the name of *salt of sorrel*. It is very sparingly soluble in water, though more so than tartar. It occurs in commerce in beautiful four-sided prisms attached to each other. The acid contained in this salt is very nearly double half what is contained in oxalate of potash. Suppose 100 parts of potash; if the weight of acid necessary to convert this quantity into oxalate be x , then $2x$ will convert it into superoxalate.

6. Oxalate of soda readily crystallises. Its taste is nearly the same as that of oxalate of potash. When heated, it falls to powder, and loses the whole of its water of crystallisation. Soda is said to be capable of combining

combining with an excess of acid, and of forming a superoxalate. I have not tried the experiment.

7. Oxalate of ammonia is the most important of all the oxalates, being very much employed by chemists to detect the presence of lime, and to separate it from solutions. It crystallises in long transparent prisms, rhomboidal, and terminated by dihedral summits. The lateral edges are often truncated, so as to make the prism 6 or 8-sided. Sometimes the original faces of the prism are nearly effaced.

The taste of this salt is bitter and unpleasant, somewhat like that of sal ammoniac. At the temperature of 60°, 1000 grains of water dissolve only 45 grains of this salt. Hence, 1000 grains of saturated solution of oxalate of ammonia contain only 43.2 grains of this salt. The specific gravity of this solution is 1.0186. As it may be useful to know the weight of this salt contained in solutions of different specific gravities, I have thought it worth while to construct the following table :

Weight of Oxalate of Ammonia in 100 parts of the solution.	Specific gravity of the solution at 60°.	Weight of Oxalate of Ammonia in 100 parts of the solution.	Specific gravity of the solution at 60°.
4.32	1.0186	1.5	1.0075
4.	1.0179	1.	1.0054
3.5	1.0160	0.5	1.0030
3.	1.0142	0.4	1.0024
2.5	1.0120	0.3	1.0018
2.	0.0095	0.2	1.0012
		0.1	1.0006

8. To determine the composition of these salts, I took seven different portions of a diluted oxalic acid solution, each weighing 100 grains, and containing seven

grains of real oxalic acid. To each of these portions I added respectively potash, soda, ammonia, barytes water, strontian water, and lime water, till it ceased to produce any change. The liquid was then evaporated to dryness, and the residue, after being well dried on the steam-bath, was weighed. Each of these salts contained seven grains of acid; the additional weight I ascribed to the base. Hence I had the following table, which exhibits the weight of each salt obtained, and its composition deduced from that weight.

Salts.	Weight obtained.	Composition.	
		Acid.	Base.
Oxalate of Ammonia	9.4	7	2.4
———— Magnesia *	9.5	7	2.3
———— Soda	11.0	7	4.0
———— Lime	11.2	7	4.2
———— Potash	15.6	7	8.6
———— Strontian	17.6	7	10.6
———— Barytes	17.0	7	10.0

The composition of these salts, reduced to 100 parts, is given in the following table.

	Oxalate of Ammonia.	Oxalate of Magnesia.	Oxalate of Soda.	Oxalate of Lime.	Oxalate of Potash.	Oxalate of Strontian.	Oxalate of Barytes.
Acid	74.45	73.63	63.63	62.50	44.87	39.77	41.16
Base	25.53	26.32	36.37	37.50	55.13	60.23	58.84
Total	100.	100.	100.	100.	100.	100.	100.

* The oxalate of magnesia was obtained by neutralizing the oxalic acid solution with ammonia, then mixing it with sulphate of magnesia, evaporating the solution to dryness, and washing the insoluble oxalate of magnesia with a sufficient quantity of water.

But

But, for practical purposes, it is more convenient to consider the acid as a constant quantity. The following table is constructed upon that plan.

	Acid.	Base.	Weight of Salt.
Oxalate of Ammonia	100	34.12	134.12
———— Magnesia	100	35.71	135.71
———— Soda	100	57.14	157.14
———— Lime	100	60.00	160.00
———— Potash	100	122.86	222.86
———— Strontian	100	151.51	251.51
———— Barytes	100	142.86	242.86

9. In the preceding statement, no account has been taken of the water of crystallisation which might still remain attached to the salts, notwithstanding the heat to which they were exposed. There is reason to believe, however, that in most of them this water must be so small, that it may be overlooked without any great error. Oxalates of soda and of ammonia, I have reason to believe, lose all their water of crystallisation at a moderate heat. This is the case also with oxalates of lime and barytes, and I presume that the oxalates of strontian and magnesia are not exceptions; but oxalate of potash retains its water much more obstinately. I believe that in that salt the weight of acid and of base are nearly equal, and that when dried in the temperature of 212° it still retains nearly 10 *per cent.* of water; but I have not been able to establish this opinion by direct experiment.

The composition of oxalate of strontian in the preceding table was so different from what I expected, that I repeated the experiment; but the result was the same.

This induced me to combine strontian and oxalic acid in the following manner: 100 grains of a solution containing seven grains of real oxalic acid were neutralized by ammonia, and the oxalic acid precipitated by means of muriate of strontian. The salt obtained weighed 12.3 grains; of course it was composed of

Acid	7	or	56.9	or	100
Base	5.3		43.1		75.7
	12.3		100.0		175.7

Thus it appears that there are two oxalates of strontian, the first obtained by saturating oxalic acid with strontian water, the second by mixing together oxalate of ammonia and muriate of strontian. It is remarkable that the first contains just double the proportion of base contained in the second.

III. *Decomposition of the Oxalates.*

1. When oxalic acid, in the state of crystals, is exposed to heat, it is only partially acted upon, a considerable portion escaping without alteration; but when an alkaline or earthy oxalate is heated, the acid remains fixed till it undergoes complete decomposition. The new substances into which the acid is converted, as far as my experience goes, are always the same, what oxalate soever we employ. They are five in number; namely, *water, carbonic acid, carbonic oxyd, carbureted hydrogen, and charcoal.*

2. The water is never quite pure. Though no sensible portion of oil can be perceived in it, yet it has always the peculiar smell of the water obtained during the distillation of wood; a smell which is usually ascribed

to

to oil. It commonly shews traces of the presence of ammonia, changing vegetable blues to green, and smoking when brought near muriatic acid; but this minute portion of ammonia is probably only accidentally present. All the oxalates which I decomposed by distillation, were obtained by double decomposition from oxalate of ammonia; and though they are washed with sufficient care, yet I think it not unlikely that a minute portion of oxalate of ammonia might continue to adhere. Practical chemists know the extreme difficulty of removing every trace of a salt with which another has been mixed.

The carbonic acid remains partly combined with the base, which always becomes a carbonate, and partly makes it escape in the form of gas.

The carbonic oxyd and carbureted hydrogen make their escape in the form of gas: the charcoal remains in the retort mixed with the base, to which it communicates a grey colour: the quantity of it depends in some measure upon the heat. If the oxalate was exposed to a very violent heat, no charcoal at all remains. Hence it probably acts upon the carbonic acid united to the base, converting it into carbonic oxyd, as happens when a mixture of a carbonate and charcoal are heated.

3. I was induced to examine this decomposition with considerable attention, because I conceived that it would furnish the means of estimating the composition of oxalic acid; and I pitched upon oxalate of lime, as the salt best adapted for the purpose I had in view. A determinate quantity of this salt was put into a small retort, and gradually heated to redness. This retort was connected with a pneumatic trough by means of a long glass

glass tube, having a valve at its extremity which allowed gas to issue out, but prevented any water from entering the tube. The experiment was repeated three times.

4. A hundred grains of oxalate of lime, when thus heated, yield above sixty cubic inches of a gas, which is always a mixture of carbonic acid and inflammable air, nearly in the proportion of one part of the former to three and a half of the latter, reckoning by bulk. The specific gravity of the inflammable gas was 0.908, common air being 1.000; it burns with a blue flame, and when mixed with oxygen may be kindled by the electric spark. The loudness of the report depends upon the proportion of oxygen.

The smallest quantity of oxygen, with which it can be mixed, so as to burn by the electric spark, is 1-9th; the combustion is very feeble, and is attended with no perceptible report. If the residue be washed in lime-water and mixed with 1-9th of its bulk of oxygen, it may be kindled a second time: this may be repeated five times, after which the residue cannot be made to burn.

The combustion becomes more violent, and the report louder, as we increase the proportion of oxygen, and both are greatest when the oxygen is double the bulk of the gas. As we increase the dose of oxygen, the combustion becomes more and more feeble; and five parts of oxygen and one of gas is the limit of combustion on this side: for a mixture of six parts of oxygen and one of the inflammable air will not burn.

In these experiments the results differ materially from each other when the proportion of oxygen used is small
and

and when it is great. I am not able at present to account for this difference, which holds not only with respect to this gas, but every compound inflammable gas which I have examined. This difference makes it impossible to use both extremes of the series: I make choice of that in which the proportion of oxygen is considerable, as upon the whole more satisfactory. The best proportion is one part of the gas and two parts of oxygen. The oxygen ought not to be pure, but diluted with at least the third of its bulk of azote, unless the gas be much contaminated with common air.

I have elsewhere detailed the method which I follow in analysing gases of this nature*. The following table exhibits the mean of a considerable number of trials of this gas with oxygen.

Measures of inflammable Air consumed.	Measures of Oxygen consumed.	Carbonic Acid formed.	Diminution Bulk.
100	91	93	98

that is to say, 100 cubic inches of the gas when burnt combine with 91 cubic inches of oxygen; there are produced 93 inches of carbonic acid; and after the combustion these 93 inches alone remain, the rest being condensed. Hence we conclude that the other substance produced was water.

This result corresponds almost exactly with what would have been obtained if we had made the same experiment upon a mixture of 70 measures of carbonic oxyd and 30 measures of carbureted hydrogen, as will appear from the following table.

* See Nicholson's Journal, 16, 247.

	Measures of inflammable Gas consumed.	Measures of Oxygen con- sumed.	Measures of carbonic Acid formed.	Diminution of Bulk.
Carbonic oxyd 70		31.5	63	38.5
Carbureted hy- drogen } 30		60.0	30	60.0
Total 100		91.5	93	98.5

This coincidence is so exact, that I do not hesitate to conclude that the inflammable gas, which was the subject of experiment, was in reality a mixture of 70 parts of carbonic oxyd, and 30 of carbureted hydrogen. The specific gravity, indeed, which was 0.908, does not exactly agree with the specific gravity of such a mixture; for $2\frac{1}{2}$ measures of carbonic oxyd, and one measure of carbureted hydrogen, ought to form a mixture of the specific gravity 0.849, provided the specific gravity of carbonic oxyd be 0.956, and that of carbureted hydrogen 0.600; but this objection cannot be admitted to be of much weight, till the specific gravity of pure carbureted hydrogen be ascertained with more accuracy than has hitherto been done.

The results contained in the preceding table enable us to determine the composition of this inflammable air with considerable precision; for 100 cubic inches of it require 91 inches of oxygen, and form 93 cubic inches of carbonic acid. But it is known that carbonic acid gas requires for its formation a quantity of oxygen gas equal to its own bulk: therefore, to form 93 inches of it, 93 inches of oxygen gas must have been employed; but only 91 were mixed with the gas: therefore the gas itself must have furnished a quantity of oxygen, equivalent

equivalent to the bulk of two cubic inches, besides all the carbon contained in 93 inches of carbonic acid.

This carbon amounts in weight to.....12.09 grains.

Two cubic inches of oxygen weigh 68

Total 12.77

But as 100 cubic inches of the gas weigh 28.15 grains, it is obvious that besides the 12.77 grains which it furnished to the carbonic acid, it must have contained 15.38 grains of additional matter; but as the only two products were carbonic acid and water, it is plain that the whole of this additional matter must, by the explosion, have been converted into water. Its constituents of course must have been

13.19 oxygen.

2.19 hydrogen,

15.38

Adding this to the 12.77 grains formerly obtained, we get the composition of the gas as follows :

Oxygen 13.87

Carbon 12.09

Hydrogen 2.19

28.15

which reduced to 100 parts, becomes

Oxygen 49.27

Carbon 42.95

Hydrogen 7.78

100.00

5. The residue which remained in the retort, after the distillation was over, was a grey powder, not unlike pounded clay slate. To ascertain its constituents, it was dissolved in diluted nitric acid with the necessary precautions; the loss of weight indicated the quantity of carbonic acid. The charcoal remaining undissolved, was allowed to subside, carefully washed by repeated affusions of water, and then dried in a glass or porcelain capsule. It must not be separated by the filter, for it adheres so obstinately that it cannot be taken off the paper, nor weighed. The nitric acid solution was precipitated by carbonate of soda, and the carbonate of lime obtained was violently heated in a platinum crucible. What remained was pure lime.

TO BE CONCLUDED IN OUR NEXT.

On the Cultivation of the Poppy for extracting the Oil.

By Dr. COGAN.

From the LETTERS and PAPERS of the BATH and WEST
of ENGLAND SOCIETY.

ALTHOUGH the experiment related in the following letter was made previous to the insertion of the article, concerning the cultivation of the poppy, in our tenth volume *, it is very satisfactory to find, that an English gentleman of respectability has paid some attention to the subject, and proposes to make farther experiments; the result of which must be beneficial, as it will increase our stock of facts, and thus become applicable to some valuable purpose.

Extract of a Letter addressed to Dr. COGAN, by
EBENEZER HOLLICH, Esq.

“ When I passed through Flanders in the summer of 1802, I saw several fields of poppies, and learnt that they were grown for the purpose of expressing oil from their seed for food; and that they fed cattle with the refuse or cake. I also learnt that they considered the oils much inferior to that made from olives. I well remember, at the *table d’hôte* at Lisle, hearing a gentleman say, throwing the cruet from him, ‘ Ah! it is poppy.’ I however, wishing to try it in England, brought a small quantity of the seed over; and on the

* See page 108 of the present volume of this work.

first of April, 1803, (I think rather too late in the year,) sowed it. I grew enough to enable me to ascertain nearly how much oil a bushel of it will produce. I tried $3\frac{1}{2}$ bushels, weighing 1 cwt. 2 qrs. and it produced 6 gallons 2 lbs. of oil, ($7\frac{1}{2}$ lbs. to a gallon,) and 3 qrs. 25 lbs. of cake; of course 12 lbs. were wasted in the working. It was worked three times over; the first run cold 17 lbs.; the second run cold 19 lbs.; the third run 11 lbs. was heated. This being so small a quantity, it cannot be quite accurate; nor were we able to have the mill so clean from rape, which it had been just working, as to give it a fair trial. But I am inclined to think, both from this specimen, and from a sample of that oil which my very ingenious friend Mr. Pugh, of Rouen, gave me when I was there, that it by no means is equal to fine olive oil for eating; but I question if it might not supply the place of Gallipoli oil, which would be a great acquisition to our manufactories, especially in time of war. And I mean next year to sow a field lately broke up from sainfoin, of about three acres, with it; by which I hope to get seed enough to ascertain its use, and how far it may be worth while to grow it in this country. You will see that my account of the oil produced from a given quantity of the seed differs much from that of Mr. Van Eys. If the sacks mentioned in your paper upon the cultivation of the poppy be four bushels each, I drew much more oil per bushel than he got. As to the cakes, Mr. Eys has given no intimation of their quantity, that is, their weight.

“I found a great difficulty in harvesting the seed. I think we plucked it up, set it upright like beans in the field, and let it stand for some days; and then brought it

it with care to a cloth laid in the field, and beat out the seed, the heads open; therefore if great care be not taken, the seed will be lost.

“You will, I am persuaded, excuse my troubling you with this, and do me the favour to communicate any thing fresh that you may have learnt upon the cultivation or uses of this article. In America, I understand, they grow the large sun-flower to express its oil. I have grown some, but there seems an insuperable objection in harvesting that; at least I have no idea how it can be done.

“Whittesford-Lodge, near Cambridge,
October 14, 1807.”

According to the above statement it appears, that the poppy oil is less palatable than was represented in the former paper. But as there are various degrees of excellency in the olive oil, this may be the case with the other. It is also probable that the *poppy* oil may maintain an uniformity more than the olive, which depends greatly upon favourable seasons for its acquiring its pleasant flavour; and without those advantages it may become much inferior to the former. This, however, is merely a conjecture, which future experience alone can confirm or confute.

It is acknowledged that the Dutch, whose domestic consumption of oil greatly exceeds our own, are not so delicate in their taste concerning that article. But as it is an indubitable truth that poppy oil is frequently mixed with the olive by the venders, when sold for culinary purposes, as it will correct the rancidity which
olive

olive oil may have acquired by age ; and as the price of the best olive oil is increasing daily, and may become too costly for common use ; it is desirable to have a substitute, though of a quality somewhat inferior. If the gentleman who threw the cruet from him with contempt was an *Englishman*, I should not much wonder at his conduct ; as the prejudices of an Englishman in the article of food are proverbial upon the continent.

But supposing that this oil should be found totally unfit for our palates, it will not be necessary to have it cold drawn, and thus it may be extracted at a much cheaper rate for other purposes, which the present situation of public affairs renders most desirable. The greater the impediments to importation of the necessities of life, the more strenuous should we be to render ourselves as independent of the continent as possible. The consumption of oils in Great-Britain, both for manufactures and for lamps, is immense ; nor can we be assured of imports equal to the demand.

Since the article in the preceding volume was written, I have received information from a friend, that the poppy oil is used in *France* and other places, in the counting-houses of merchants, in preference to any other. It is said to give a more vivid light, and to be much freer from fuliginous vapours.

T. COGAN.

List of Patents for Inventions, &c.

(Continued from Page 288.)

CHARLES GOSTLING TOWNLEY, of Ramsgate, in the county of Kent, Esquire ; for a key which regulates the tone of the flute, or other musical instrument capable of the improvement, by causing the box of it to lengthen or contract at pleasure ; which key may be called *The Tone regulating Key*. Dated August 9, 1808. Specification to be enrolled within one month.

JAMES GALE, of Shadwell, in the county of Middlesex, Ropemaker ; for certain improvements in rope-making. Dated August 18, 1808. Specification to be enrolled within one month.

ALEXANDER TILLOCH, of Barnsbury-street, Islington, in the county of Middlesex, Gentleman ; for a new physico-mechanical power, or, in other words, improved machinery or apparatus capable of being employed as a moving power to work or drive machinery and mill-work, and applicable to other useful purposes. Dated August 20, 1808. Specification to be enrolled within six months.

THOMAS PRICE, of Bilston, in the county of Stafford, Coal-master ; for improvements in the application of steam for useful purposes, and in the apparatus required to effect the same. Dated August 24, 1808. Specification to be enrolled within one month.

THOMAS MEAD, of Scott-street, in the parish of Sculcoates, in the county of York, Engineer ; for a method or methods of making and constructing circular or rotative steam-engines upon an entire new principle, and employing the elastic or expansive force of steam in a
much

much more efficacious and advantageous manner than has hitherto been done. Dated August 24, 1808. Specification to be enrolled within one month.

WILLIAM CONGREVE, of Garden-court, in the Temple, in the county of Middlesex, Esquire; for a new principle of measuring time, and constructing clocks and chronometers. Dated August 24, 1808. Specification to be enrolled within one month.

JOSEPH CUFF, the younger, of Whitechapel, in the county of Middlesex, Cheesemonger and Bacon Merchant; for certain machinery for the more easy, expeditious, and better method of slaughtering hogs, bullocks, and other cattle, whereby much labour will be saved, and the flesh of such cattle greatly improved in quality, and will be more easily and better cured and preserved. Dated August 25, 1808. Specification to be enrolled within six months.

JOHN DUMBELL, of Mersey Mills, in the parish of Warrington, and county palatine of Lancaster, Miller; for a method or methods of flax-spinning, and of preparing or making a special twist thread, furniture, cloth, frills or attire, which he calls *Telary Teguments*, from silk, wool, cotton, flax, hemp or tow, as well as from a great variety of other articles (in a combined or uncombined state); and for a method or methods of re-fabricating or renovating the same, and of producing or reproducing from tatters in general a new body. Dated August 25, 1808. Specification to be enrolled within six months.

THE
REPERTORY
OF
ARTS, MANUFACTURES,
AND
AGRICULTURE.

No. LXXVIII. SECOND SERIES. Nov. 1808.

Specification of the Patent granted to JOHN WATSON, late of Bury-place, Bloomsbury, in the County of Middlesex; Gentleman; for certain Improvements in the Art of Soap-making, by which the Article is in several Respects ameliorated. Dated May 10, 1808.

TO all to whom these presents shall come, &c:
NOW KNOW YE, that, in compliance with the said proviso,
I the said John Watson do hereby declare that the nature of my said invention, and the manner in which the same is to be performed, are particularly described and ascertained as follows; that is to say: After the soap has been formed or made in the usual manner, by boiling fat or oil with soap lees, or the solution of a considerably pure alkaline salt, and separated by the addition of common culinary salt, I do not put the same into the forms in order that it may become indurated for sale, but I diffuse the same in a large quantity

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of pure water, with or without the assistance of heat, as may for the sake of expedition be preferred. And I do again separate the said soap by the addition of common culinary salt; and I do repeat the said process of solution and separation a greater number of times if necessary; and I do declare that the chief intention and purpose of the said process is to render the soap more perfectly neutral, by separating any uncombined alkali which may have subsisted in the first making, and also to throw up any uncombined oil in case the boiling should not have been carried to the precise point which is needful for the formation of good soap. And farther, I do declare that I do make use of the same process for purifying and perfectly neutralizing such soaps as have been already made and completed in the common way, by myself or other manufacturers; in order to which it is convenient that the solid soap should be rasped or scraped, or dried and pulverised, or otherwise divided by mechanical means, for the purpose of expediting the diffusion and solution, or suspension, of the same in the fluid. And farther, that I do manufacture a soap of uncommon beauty, closeness, and uniformity of texture, by the use and application of alcohol or ardent spirit, as follows; namely, I make a pure soap, or purify soap already made, by using the processes hereinbefore described; or in case I find upon examination that the soap intended is sufficiently pure, I take the same without farther preparation, and in preference I do subdivide the same into shavings, or small portions, by the means herein before mentioned; and I do make a mixture of about one part, by weight, of the spirit, and two parts, or thereabouts, of the pure soap, but these proportions

proportions will admit of considerable variations; and I do cause the same to unite by moderate boiling, and in this state I pour the same into moulds, to be divided into lengths, or squares, or cakes, or other fit proportions, for sale; and I do expose the said lengths, squares, cakes, or proportions, in a fit place or apartment, kept at a proper temperature for drying or evaporating the solvent or spirit, or a considerable portion thereof, in order that the density and consistence of the said soap may increase, and its parts become so intimately applied to each other, as to produce a beautiful degree of transparency. And, lastly, I do declare that in some cases I add a portion of sugar or saccharine matter to the mixture when a less degree of firmness is required; and that I do, as occasion may require, add such well-known materials as may be needful to give any particular odour, or scent, or colour, as may be thought or found most agreeable to the purchasers, and concerning which said materials no particular instructions are necessary, because I follow the usual practice in the use and application thereof, and do not consider the same as constituting any part of my said improvements.

In witness whereof, &c.

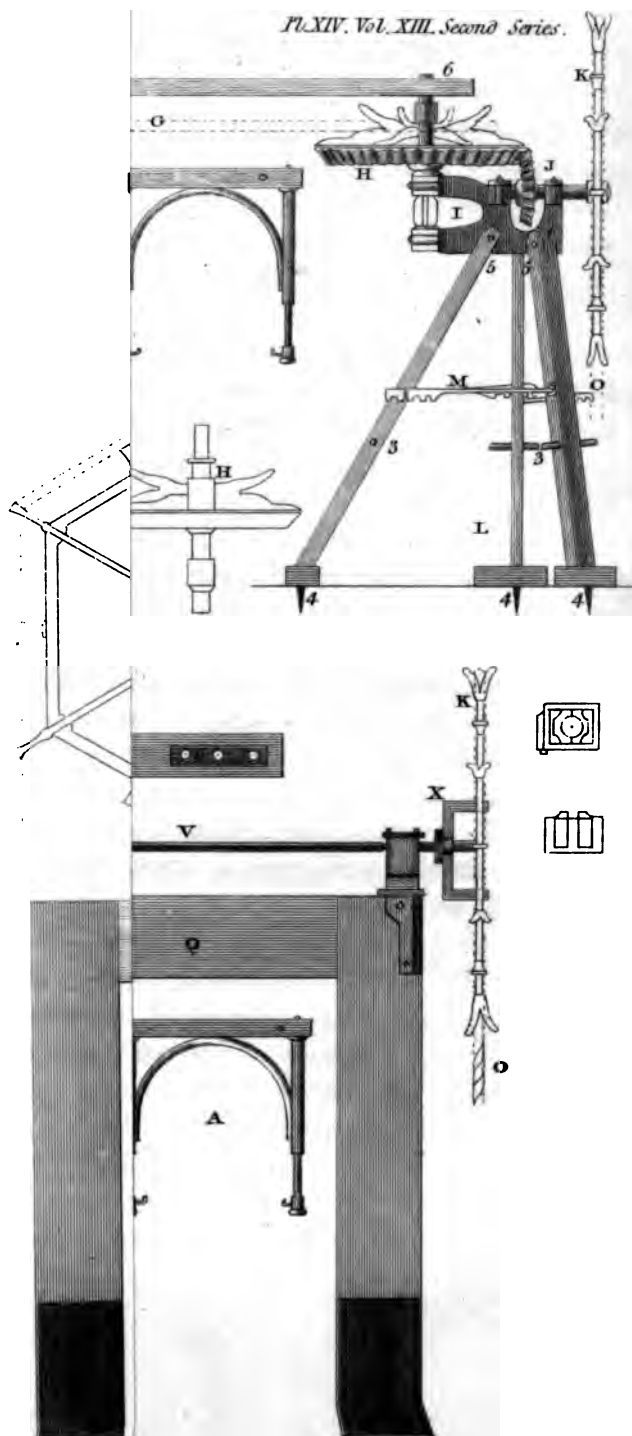
Specification of the Patent granted to WILLIAM LESTER, of Piccadilly, in the County of Middlesex, Engineer; for an improved rotary Motion or Engine to communicate power to Machines. Dated June 19, 1806.

With a Plate.

TO all to whom these presents shall come, &c. **NOW KNOW YE**, that in compliance with the said proviso, I the said William Lester do hereby declare that my said invention is fully described and ascertained by the following description, and the drawings hereto attached.

A A, Fig. 1 (Plate XIV.) the shafts or levers to which the horses or oxen are yoked. **B B** cast-iron sockets in which the levers are fixed; in the centre of which is a female screw, Fig. 3, into which the male screw **E** works, which prevents the shafts dragging the horses forward when they stop suddenly, when it is attached to a machine that has great velocity. **D** a cylinder of cast-iron bolted to **B**, which is bored to receive the screw **E**, and turned to work in the cylinder **C C**, which is also made of cast-iron and bored, to which the step **I** is bolted to receive the toe of the screw **E**. **F F** a horned wheel, made of cast-iron, round which the rope or chain **G** works, also round the horned pinion **H**, which is cast on the back of the bevel-wheel, to give the vertical motion **J**. **I** a cast-iron chair, fixed upon the portable tripod **L**. **K** a horned wheel, working vertically, round which the rope **O** works; also round a horned pinion, which is fixed upon the machine, to which the power is communicated. **L L** portable tripods, which expand and contract to raise or lower the engine to the size

PLXIV. Vol. XIII. Second Series.



size of the horse; also to contract into less space, to facilitate its removal from place to place. M M six gages of iron, to prevent the legs of the tripods from flying out. N N a beam of timber, to keep the rope or chain tight, which is regulated by the holes 6 6. 1 2 the coupling brasses which fit in the chair I. 3 3 3 3 handles to lift about the tripods. 4 4 4 4 4 4 iron spikes to prevent the tripods slipping. 5 5 5 5 bolts to which the legs are fastened to the chairs, and must be slackened when the engine is taken down for removal, and screwed tight before it is put to work. 7 7 7 7 bolts that fasten the levers.

A A, Fig. 2, the shafts. D a cylinder to receive the screw-shaft as above, but cut off at 8, and cast hollow to receive the clutch end of the axis T. K K horned wheels, which carry the rope or chain O; one of which is fixed on the machine to which the power is communicated, and are varied in size in proportion to the velocity required. P P a cast-iron chair, bolted to the beam of timber Q Q. R a foot that supports the screw-shaft; the steel toe of which turns in the chair S S. V the tumbling shaft, on the end of which is fixed the clutch X, which greatly facilitates the hanging the wheels K K. 7 7 bolts that fasten the shafts A A in the boxes B B; the screw E working in the box D, which is bolted to B B, prevents the horses from receiving any injury by stopping suddenly, as the instant the impelling power ceases the shafts A A are at rest.

In witness whereof, &c.

Specification

Specification of the Patent granted to JOSEPH WILLMORE, of Birmingham, in the County of Warwick, Sugar-smith, and JOHN TONKS, of the same Place, Plater; for a new Method and Processes in the manufacturing of Nails. Dated May 28, 1808.

With a Plate.

TO all to whom these presents shall come, &c. NOW KNOW YE, that in compliance with the said proviso, we the said Joseph Willmore and John Tonks do hereby declare that the nature of our said invention, and the manner in which the same is to be performed, are as herein hereafter set forth; that is to say: We take a nail-rod, of a size suitable to the size of the nail intended to be manufactured, and applying it to a common screw-press, mounted with proper cutters, cut off from the end of the rod two pieces at once, obliquely across the rod in one place, and directly across it in another, as is shewn in Fig. 1, (Plate XV.) at *a c* and *b*. Two studs or stops are set up, one at *c* and the other at *d*, which are attached to the press, and are adjustable by screws or other means, the stud *c* being adjustable or moveable in the direction of the rod, for the purpose of ascertaining the length of the nail, and both *c* and *d* being adjustable in the cross direction of the rod, so that the rod being pressed gently always against *c*, and sideways against *c* and *d*, the obliquity of the cut, according to the kind of nail to be made, is thereby determined, as well as the length of the nail; and the length of the two pieces may either be nearly equal or unequal, by means of the said adjustments, as will be evident on due consideration. This may be called the first operation.

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The second operation is to anneal the pieces so cut off, if the iron should not be sufficiently malleable, which we do in the usual and well-known manner.

The third operation is that of heading, which for clasp-head nails consists of two parts, one for gathering and the other for forming the head of the nail. The first part of this operation is performed by putting a piece cut off the rod of iron, as before described, into a pair of clams, leaving as much of the thick end projecting above the clams as is sufficient to form the head. These clams have steel bits let into them with sharp edges, which press only against the two opposite sides of the piece, and which have the effect of two chisels when the punch of the press is brought down upon the piece with considerable force, and raise or gather up iron on each side towards forming the head. The second part of this operation is to put the piece thus prepared into another pair of clams, having bits formed to correspond to the under side of the head; and the punch, having the impression of the upper side of the head engraved or sunk into it, is brought to press strongly upon the head in the clams, and thereby the clasp-head is properly formed. For nails intended to have rose heads, or any other kind of heads, except clasp heads, the first part of this operation is not absolutely necessary, though we think it advisable to be done, but the bits which for clasp nails must have sharp edges, must for other kind of nails have blunt edges, to prevent the under cutting. For the second part of this operation the piece is put either into a pair of clams or into the tool commonly called a bore, and then pressed with punches, properly engraved or sunk, according to the kind of head wanted. By the first operation the
piece

piece cut off the rod of iron is formed something like a mortise-chissel, the present or fourth operation is to point it, which is done by putting the piece into a bed of steel, in which is cut a nick or groove *d*, having parallel sides, see the plan C, Fig. 2, but the bottom rising towards the end where the point of the nail is to be formed, see the section B of the bed. The punch is shewn at A, and the end which presses upon the point of the nail is made to project farther than the other part, so as to meet the corresponding part of the bed when the punch is brought upon the nail. The groove or nick in the bed should be just wide enough to receive the piece easily, but prevent it from twisting when the impression is made. The piece is put twice into the nick; once with the chissel end lying horizontal, and next turned a quarter round to press the chissel edge into a pointed form. If the nails by the strong pressure which is necessary in this operation should become too hard to clench, we in such case anneal them in the ordinary way, which may be called the fifth operation.

The third, fourth, and fifth operations above described we apply to nails, or pieces cut off from sheet or rolled iron in the ordinary way; but as they, in consequence of the fifth operation, which is necessary to give them the quality of clenching, are apt to be too soft to drive well, we apply a sixth operation, *viz.* quenching them when red hot in water, or other proper fluid, which gives them stiffness enough to drive without destroying the quality of clenching.

Fig. 3 shews a pair of clams, with bits or dies let into them, which can be renewed from time to time with

more

Fig. 1.

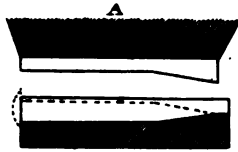
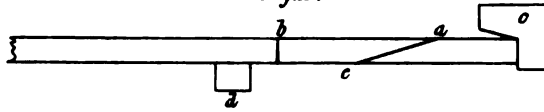


Fig. 2.

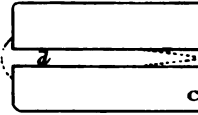


Fig. 3.

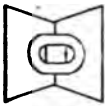
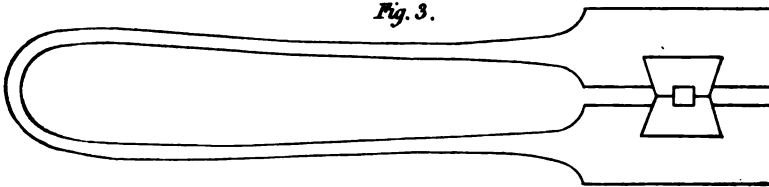


Fig. 5.

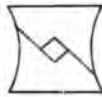


Fig. 4.

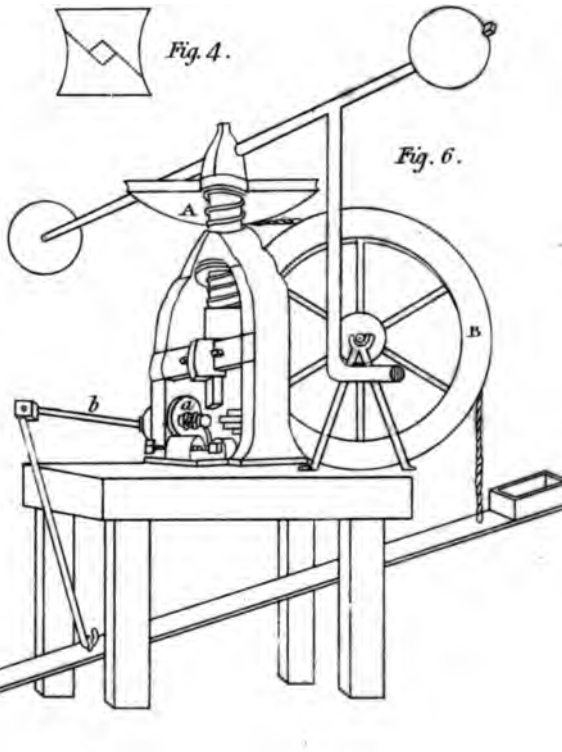


Fig. 6.

more ease, and at less expense, than by the usual method. These bits are proper for the first part of the third operation.

Fig. 4 a pair of bits or dies proper for making either rose heads or flat heads.

Fig. 5 a pair of bits or dies proper for the second part of the third operation for clasp head nails: the dotted lines shew the head of the nail.

Fig. 6 is a view of the common screw-press; in which is shewn the side pin or screw *a*, by which the clams are firmly pressed together at the time the punch is pressed down upon the nail. This pin or screw is generally worked by the foot by means of the lever *b*, connected with a treadle, while the hand applies its force to the handle of the fly; but we fix to the head of the main screw a portion of a pulley A (or a whole one), to which is attached a rope, chain, belt, or other connecting pliable material, which flying round the edge of another pulley B fixed to the frame of the press, and standing vertically descends, and is attached to the moveable end of the treadle; and on this treadle we place a weight, heavy enough to press the clams together with sufficient force.

By means of the latter-described machinery, which we only claim as our invention, the operation of pressing is performed by the action of the hand only, and is found very convenient.

In witness whereof, &c.

Specification of the Patent granted to JOHN STEDMAN, of Horton Kirby, in the County of Kent, Farmer; for a Patten and Clog, being of infinite Utility and Ease to such Persons as may wear them.

Dated May 24, 1808.

With Engravings.

TO all to whom these presents shall come, &c. NOW KNOW YE, that in compliance with the said proviso, I the said John Stedman do hereby describe and ascertain the nature of my said invention, and in what manner the same is to be performed, by the plan or drawing at the top of these presents, and the following description thereof; that is to say: the bottom or sole-part of the clog is divided into two or three parts or pieces.

Fig. 1 (Plate XVI.) shews the clog in two parts. A the fore-part; B the hind-part. The clog is made of cork, wood, or any material. But I claim the exclusive right of using cork, as being a new manufacture for clog or pattens, either with or without my new-invented principle, as will be hereafter described. To the fore-part A are fixed the ties, or a toe-piece or covering of the shoe, which may be made agreeably to the taste of the maker or wearer. To the hind part B, round the heel from E to G, is put a piece of stiff leather, or thin plate-iron or tin; it may be either nailed, screwed or sewed on, as shall be found most convenient. This piece of leather or tin stands up about three quarters of an inch, but it must be regulated according to the heel of the shoe which it is intended to receive or encompass.

This

This piece, when made of iron or tin, must be covered or lined with leather, or some soft material, to prevent rubbing the shoe or heel. The two pieces or parts A B are joined together by a hinge made of any metal.

Fig. 2 shews the hinge fixed to the two pieces A B. C the hinge: this hinge is fastened either with screws, nails, or rivets. To the under-part of this hinge is riveted a spring or springs.

Fig. 3 shews the spring fixed to the hinge, and in action.

Fig. 4 shews the spring, with the hinge annexed inactive. The clog should always be made to fit the shoe, so that when it is on it should be straight, or in the position of Fig. 5, which shews the spring active.

Fig. 6 shews the position of the clog when off the foot and the spring inactive. There must be nailed or screwed a piece of thin leather along the joint, to prevent the wet or dirt getting to the springs, which would impede their action. My second mode of joining the two parts A B, and making the clog act on my patent principle, is by fixing a flat spring or springs, bent in a curve.

Fig. 7 shews a side view, and Fig. 8 shews a perpendicular view of the spring. One end of the spring is to be screwed or nailed to part A, on the other end to part B of the clog. The sole of the clog may be divided into three parts or pieces, and the spring-hinge put to each joint; or the joint nearest the toe may have an hinge of metal or leather, without a spring. The flat spring, as above described, can be put to join the three pieces together.

Fig. 9 shews a perpendicular view of the clog, with the flat spring fixed by screws or rivets to each piece;

B b b 2 the

the ties of the clogs may be fixed on the toe or middle piece, or a tie on each, which shall be found most convenient.

The intent of my new invention, and of those springs above described, are to prevent the clog coming off the foot; to remove the usual unpleasant clacking noise; to hinder the dirt throwing up; and to facilitate and lessen the fatigue of walking to the sole part of my clogs. And to make them into a patten there are put on the under-side, both on the fore and hind-part, a piece of thin plate or sheet iron rim, nearly the shape and size of the part A and B; the depth of this piece of iron must be regulated according to the height of the patten, from one quarter of an inch to two or three. The ends of these pieces of iron are riveted together, and there are three or four little pieces turned down, with holes made in them, to screw or nail the rim to the bottom or sole parts.

Fig. 10 shews the under side of the patten. H H the iron rim: within this rim is put a piece of cork, nearly to fill it up. M M the cork: this cork is fastened by a screw passing through it to the bottom, or a screw or two put through the rim into the cork. The intent of this cork is to strengthen the rim, and to prevent its being filled up with dirt. This rim of sheet iron may be put to the bottom of a common clog if required; in that case the rim may be made in one piece, as Fig. 11. W the inside of the rim. This rim is to be filled with cork, to prevent its being filled with dirt.

In witness whereof, &c.

Observations

Observations on several of the Articles inserted in our last Number.

Communicated in a Letter to the Editors.

GENTLEMEN,

IN your last Number a contrivance is described for preparing Mercurial Ointment ; but whatever superiority it may possess over other Mills for grinding Colours, &c. I am certain of this, that by the means pointed out, namely, by an *endless screw* on the axis of the handle, turning a *wheel* fixed on the axis of the pestle, the inventor will never obtain what he mentions, a *rapid movement*. To do this, he ought to have placed a bevil, or contrate wheel, on the axis of the handle, to drive a pinion of much smaller diameter fixed on the axis of the pestle, or more properly speaking, the grinder of his apparatus.

In the same Number I also find described a Waggon with swinging Axle-trees, {connected with each other by diagonal chains ; this is a very old invention, and is already published in Bailey's Advancement of the Arts, and a model of it is deposited in the Model Room of the Society of Arts, &c. &c. in the Adelphi.

I observe that you have published in the same Number also, an extract from the last volume of that Society's Transactions, descriptive of Mr. Daniel's Life Preserver ; and very properly likewise, the Patent taken out by Mr. William Cobb for a similar contrivance so long since as the year 1764, with a note pointing out that similarity ; to which, however, you might have added, that such an apparatus, with various modifications of it,
is

is described in a German work, published in the early part of last century, viz. *Leopold's Treatise on Medicines*. A similar contrivance is likewise published in the title of a well-known work, *A Thousand Noddie Things*; and also in the different *Encyclopedias*, as *The British, Helios*, and others, under the name of *Air Jacket*, and still more, that such Air Jackets were upwards of 50 years since commonly exposed to sale, together with Cork Jackets at the trunk-makers in London. Now I am upon the subject of Cork Jackets, permit me to add, that a much smaller quantity of cork than is commonly supposed, sufficient to support the human body in water; for two pieces, about three quarters of an inch thick, and eight or nine inches square, enclosed in callico, flannel, canvas, oiled silk, &c. and one of each fixed beneath the arm-pits by means of two straps or tapes passing over the shoulders, and two others to tie them round the body, are quite sufficient to keep the head and shoulders out of the water, either in standing erect therein, or in swimming. &c. and, I believe, will be found the best mode of applying cork to so valuable a purpose. It might be well to make hollows or depressions in the upper edges of the corks, rounded off so as to fit the arms better; and, if the pieces were either chosen bent, so as to be close to the ribs, or bent by heating them, it would be better.

I am, Gentlemen,

your most obedient servant,

T. G.

Graham's

*Graham's Dead-Beat improved.**By Mr. R. KING, of Scarborough.*

With an Engraving.

Communicated in a Letter to the Editors.

TO draw this escapement, having drawn the wheel with its thirty teeth, and marked off the half tooth required for the progressive motion of the wheel, then from the centre of the wheel through the points *e* and *g* draw the lines *D E*, Fig. 12, (Pl. XVI.) and *D F*; then from the points *e* and *g* in these lines draw the tangent lines *g C* and *e C* intersecting each other in the point *C*, where the centre of the verge must be fixed; then through the point of the tooth *h* draw *C K*, being the line of impulse; then at the angle of 45° draw the line *L B*, which gives the inclined plane of the pallet *B*, which being continued to the line *D E*, forms the face of the pallet; then through the point of the pallet draw the line *C M*, being the line of its escape; then draw the line *C N* through the point of the tooth *i*, the line of its escape, and with same angle as *K C M*, draw the line of impulse to the pallet *A*, and at 45° draw *g P* for the face of that pallet; then draw the body of the pallets completing the whole.

The improvements I have added to this Escapement, are, that the face of the pallets act at an angle of forty-five degrees, instead of sixty, which was the angle used by Graham; the angle of 45° acting with more freedom without checking the vibration by the impulse; and I also place the centre of the pallets in the intersection of the tangent lines, by which means the friction of swinging into the teeth is abated. It yet remains
with

with difference of power in the action of the pallets, the tooth that swings the pallet on the right-hand side in the drawing, gaining power in the impulse by getting to a greater distance from the centre of the verge, while the left-hand pallet loses power by its approach to the centre; yet, with these inconveniences, it is much better than any Escapement, with locking and loosing detents.

I am, Gentlemen, yours, &c.

R. KING.

Scarborough, May 30th, 1808.

Account of the Wheat Moth, or Virginia Fly; as it appeared in France in the year 1755; and which damaged the Grain in the Township of Lower Dublin in the Harvest of 1802, 1803, and 1804.

From the LETTERS and PAPERS of the BATH and WEST of ENGLAND SOCIETY.

THE inhabitants of a considerable part of the province of Angoumois, in France, had for a period of thirty years sustained an immense loss by the ravages of this insect. It appeared at first only in a few hamlets, but soon made so rapid a progress as to spread to the lands of upwards of two hundred parishes. In the year 1755, Messrs. Duhamel and Tillet were deputed by the Academy of Sciences at Paris, of which they were members, to enquire into the nature of this insect, and the means of preventing and curing the dreadful calamity occasioned thereby. The description given of it by these gentlemen is so minute and particular, as to leave no room for doubt of its being the same we have in America. It resembles the moth which preys upon
woollen

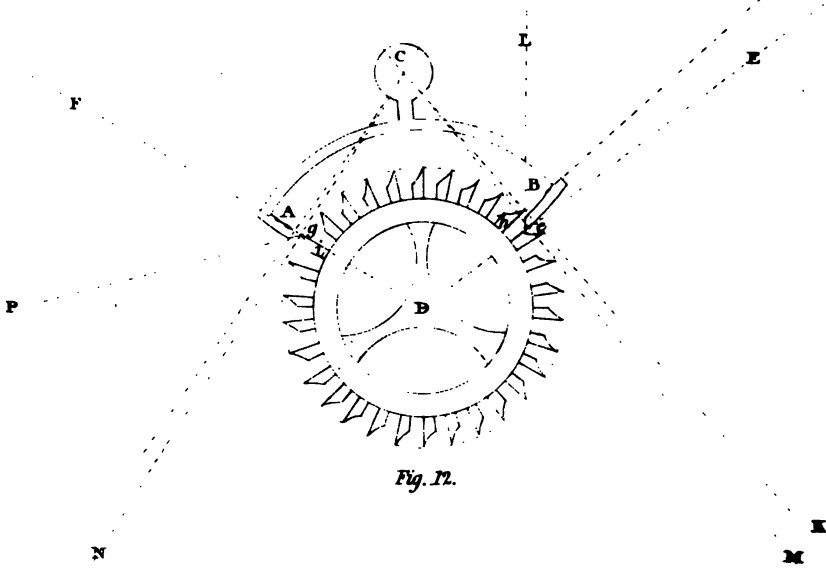


Fig. 12.

Fig. 8.

Fig. 7.

Fig. 1.

Fig. 2.

Fig. 4.

Fig. 9.

Fig. 10.

Fig. 11.

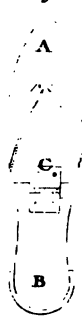


Fig. 3.

Fig. 5.

Fig. 6.

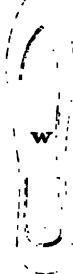
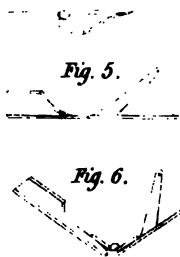


Fig. 13.



Fig. 14.



1. The first part of the document is a list of the names of the persons who were present at the meeting.

woollen cloths, and is of the class of four-winged *phalæna* or night-butterflies. In this state, however, they do not take any food, nor do they destroy the grain during that time, for they have not organs capable of doing it even the least injury. Their only function then is to propagate their species. They couple in the manner of the silk-worm butterfly; and as soon as the female is impregnated, she lays her eggs in great numbers, in heaps of sixty, eighty, or ninety together. They are accompanied with a viscous matter which makes them stick to the places they are laid in, and this cohesion soon becomes very strong. They are so extremely small that one of them would drop through a hole made in a bit of paper with the point of the finest needle. The female butterflies which are upon the ears of grain in a field endeavour to place themselves in such a manner as to lay their eggs close to the joining of the grain to the stalk. In six or seven days each of them produces a caterpillar, in appearance like a bit of hair about the twentieth part of an inch long, at first reddish; but afterwards almost white. As soon as the caterpillars are hatched, they set about making their way into the grain in order to feed upon its flour. If the eggs have been laid in the granary after harvest, and upon the grains themselves, they generally creep into the furrow of the wheat and there weave a slight web. They then tear a hole in the skin or rind, range round them the particles of bran thus separated, and wriggle themselves into the mealy substance which is to be their food. The hole through which the caterpillar entered can then no longer be perceived but by a little heap of bran which lies upon it, and which may easily escape the notice of

those who have not observed it before, but when once known is easily distinguished. When the eggs are hatched upon the ears in the field, the young caterpillars soon find means to glide in between the chaff and the grain, and in that situation they pierce the latter, as was said before, generally in the furrow, but sometimes at the pointed end, which is a little hairy. As the husks of barley are harder, and stick much closer to the grain than those of wheat, it is almost always at the point that these caterpillars enter, by means of a small opening perceptible in that part. Notwithstanding the industry of this insect, it seems highly probable that the young ones meet with great difficulties in their attempts to get into the grain, since very many of them die before they can effect a lodgment in the mealy substance. But considering the vast fecundity of the females, if prodigious numbers of them did not perish, it would be hardly possible to save a single grain of any kind. The people of Angoumois were strongly of opinion that the mischief occasioned by this insect was peculiar to the grain of their country, and that what was brought to them from other places always escaped unhurt. To clear up this point, Messrs. Duhamel and Tillet put into different glasses wheat of the growth of other provinces, and, with grains in each glass, some of these butterflies actually coupled. They soon saw the female lay her eggs upon these grains, and afterwards the caterpillars hatch and make their way into them. Their further observations proved that the principal cause of the spreading of this evil is, that the insect itself, which multiplies exceedingly, is conveyed to other parts with the grain in which it is inclosed. Whenever a grain was opened

opened in which the caterpillar was not fully grown, a deal of flour yet remained; but when full grown, nothing was left but the skin or bran, so destitute of flour as not even to discolour clear water. Hogs would not touch these hulls when given to them unmixed. The length of the caterpillar, when full grown, is very little more than the twelfth part of an inch, and its thickness is at most equal to half the circumference of the grain that contains it. Its body is smooth and entirely white; it is thickest towards the head, in which one may perceive its mouth, two large eyes, and two kinds of hair; the head is a little browner than the rest of the body. It has sixteen legs, of which the eight intermediate and membranous are only small prominences, so minute as not to be distinguished even with the help of a microscope, unless the insect be laid upon its side.

The caterpillar, exactly inclosed in its grain, before it is changed into an aurelia, makes therein a small trap-door which remains shut. The butterfly being entirely formed in the aurelia, breaks the skin of it at the end, opens with its head this little trap, and comes out at the hole which was covered and shut by it. As soon as the butterflies are out of the grains which contained them, they couple, and the females lay their eggs in the manner before related. This insect, like all others of the same species, remains a longer or shorter time in its different states according to the temperature of the air. It will continue three months in the state of an aurelia, if put into an ice-house, and the butterfly does not, in that case, come out till after it has been removed into a much warmer air. The coming out of the butterflies is generally denoted by a great heat in the heaps of grain, or in the sheaves, according as it is laid up, in one or

the other. This heat certainly accelerates the hatching of the insects, for prodigious multitudes of butterflies issue out of the heated grain in a few days after the ferment has taken place. When the harvest is out, and warm rains fall at that time, this heat comes on very soon, and then these insects make an extremely rapid progress. A hot and dry season which hardens the grain may defer the evil, and perhaps lessen it a little, but this is all. These caterpillars, inclosed in their husks, and sheltered in barns and granaries, are screened from the vicissitudes of the air, and when circumstances are favourable, again make their appearance. At harvest-time butterflies were seen to come out of some grains, which were already empty and entirely consumed before they were reaped. Probably these first butterflies couple and lay their eggs upon the other unreaped ears, and part of these eggs are destroyed by the action of the flail when the grain is threshed and cleaned soon after its being cut; but as the caterpillars are hatched very speedily in hot weather, and many of them enter into the grain that is reaping, and shelter themselves there, they will do all their mischief, if speedy care be not taken to stifle them. Grain reaped and piled up heats, and the transformations of the insects inclosed in it are then the sooner effected. When the sheaves are stirred, vast numbers of butterflies come out of them, and the grains from which they issue are empty of flour, and absolutely spoiled. The moment these butterflies are out of their prison, they couple and lay their eggs upon the ears which they find in the barn. Part of these eggs, and of the young caterpillars, may certainly be destroyed by the flail and winnow if used speedily. Floating the grain does not effectually separate the damaged from the sound :

sound: for that in which the caterpillars have not eaten much of the flour will sink along with the good, and the insect will remain to finish its work, which is facilitated by the softening of the grain in the water. To grind the whole produce of the crop immediately after harvest, were it practicable, would be attended with inconveniences; and though the friction of the mill-stones should destroy almost all the insects, it is not certain but that some of them may escape, and go through their metamorphoses even in the flour itself. From what is laid up in granaries issue multitude of butterflies, which couple and lay an immense quantity of eggs, from whence proceed caterpillars, which get into the grain and devour their inside during the whole winter. Numbers of live caterpillars have been found in them at that season, many aureliae towards the end of May, and prodigious multitudes of butterflies issue from them as soon as the weather begins to be hot. Thus it seems that there are two flights of them, one which appears from harvest time till the weather grows cold in October, and the other which appears in June and lasts till harvest. Those of the summer flight remain in the barns and granaries attached to the grain laid up there, upon which they couple and lay their eggs. It looks as if they knew that there is no longer in the fields any grain fit to feed their posterity. On the contrary, those of the spring flight endeavour to get out of the granaries, and do in fact get out in vast numbers through the windows to spread in the fields and lay their eggs upon the yet green grain. That this is really the case, and that these insects are a species of night-moth, appeared evidently from several very accurate observations made by Messrs. Duhamel and Tillet. They went at different hours of the

the

the day into granaries infected with them. While the day lasted, they perceived a multitude of butterflies, which stirred a little upon the heaps but did not quit them. When they returned into the same granaries a little after sun-set, they saw those butterflies rise and fly to the walls, where they settled for a while, after which they took their flight in vast numbers through the windows. As these little insects fly very swiftly, and rise to such a height that the eye cannot follow them long, especially when the dusk of evening comes on, Messrs. Duhamel and Tillet were obliged to try several methods before they could be certain what became of them. The caterpillars found in the standing ears made them conclude that the butterflies, when out of the granary, flew directly into the green grain and laid their eggs upon it while yet tender; but none of the country people of whom they enquired had ever observed them in the fields, or could give any satisfactory account of them. They searched all the neighbouring fields, and beat even the surrounding hedges at all hours of the day, to no purpose—not a butterfly could they find, excepting a few dead and dried ones entangled in spider-webs. This very circumstance led them to the discovery they were in quest of; for rightly reflecting that these insects, which neither they nor any other persons had been able to find in the fields in the day-time, must certainly be of the phalænæ or nocturnal kind, they without farther delay set out with a candle and lanthorn, repaired to one of the fields they had visited in the afternoon, and soon descried a great number of the very butterflies they were seeking for upon the beards of the ears of wheat. They returned to the same spot early the next morning, and could not then find a single one. It was proved by the following experiment,

experiment, that it is possible the caterpillars may live under ground, pass the winter there inclosed in the grain with which they are sown, and even undergo their several metamorphoses in the earth, so as to arise from thence in the form of butterflies in the spring. A wooden box was divided into three partitions, and filled with common mould taken out of a kitchen-garden. Wheat, known to be infected, was planted an inch deep in one of these partitions, two inches deep in another, and three inches in the third. All of them were then covered with a glass frame, and butterflies soon appeared in each of the divisions, but they were far the most numerous in that where they had been buried but an inch deep. In another trial a number of infected grains were covered with a still stiffer earth, wetted and pressed down, and not any butterflies appeared there. From hence, Messrs. Duhamel and Tillet concluded that though some of these insects can and certainly do come out of the ploughed ground which has been sowed with infected grain, their number is comparatively small, and that mills and granaries are the great source of their increase; for the grain which contains a young caterpillar, will grow if its germ has not been damaged, and as its mealy substance is consumed by the plant, the caterpillar must die for want of food; besides, as is proved by the experiment above mentioned, the butterflies cannot pierce through a close and hardened earth, which generally is the case of ploughed land that has been exposed to the winter rains. It is not agreed whether these insects prefer wheat, barley, or rye. The observations made by Messrs. Duhamel and Tillet seem to prove that they attack indifferently whichever lies most convenient for them; and that they do not spare
Indian

Indian corn when stripped from its stalk, and laid up in a granary where they can come at the soft inside part of grain. Even oats, when mixed with wheat, barley, and rye, in a glass vessel into which some of the butterflies were put, were damaged by caterpillars as much as any of the other grain, though it is certain that they do but little mischief to oats in the granary.

To preserve the grain from farther injury after it is reaped, it should be threshed out as soon as possible; and such part of it as it is wished to preserve either for seed or grinding, should be dried in an oven or kiln, in which the heat should be strong enough to kill the caterpillars without destroying the vegetative principle. This will be effected by 124 degrees of heat of Fahrenheit's thermometer. Or the seed-grain may be better prepared by being soaked in a strong ley of wood-ashes and quick-lime heated to such a degree that the finger can just bear it. Let the grain, contained in a basket, be stirred in this ley, and the grains skimmed off that float on the surface. When it has been thus soaked for about two minutes, the basket which contains it should then be lifted up and suspended by two poles till the ley is drained off. The grain should then be spread very thin on a floor to dry, while a second basketful is prepared in the same manner. When thus steeped and well dried it will keep a year, and continue fit for sowing.

In France mills and granaries, where large quantities of grain were deposited, seem to have been considered as the chief sources of the evil. But in this country it cannot be the case, at least not to so great an extent. No large quantities remain on hand when the warm season approaches, and kiln-drying might destroy any caterpillars which might then exist. It appears that the
severity

severity of a hard winter cannot be depended on for this purpose, but that a sufficient number may survive, even in the grain sown, to cause considerable mischief. The roller may, however, be of service to prevent the fly from making its way out of the ground. The principal danger seems to exist in the Spring barley, which having been kept under cover during winter, and afterwards sown in fresh-ploughed, and consequently light soil, will, if at all affected, be sufficient to spread the evil far and wide. To this cause the writer chiefly attributes the damage last season to a crop of wheat, the seed of which had been brought from a distance, and was perfectly free from the fly, which the barley was not, and was sown in the same field. If attention be paid in the ensuing spring to the kiln-drying of the grain that remains on hand, to the rolling of that which is coming up, and the pickling of the seed-barley, we may hope to put a stop to this distressing calamity, or at least to prevent its spread; but let it be remembered, that the remedy in order to be *effectual*, must be *universal*.

Lower Dublin, Feb. 1805.

*Account of the Produce of Milk and Butter from one Cow.
By the Earl of CHICHESTER.*

FROM THE COMMUNICATIONS TO THE BOARD OF
AGRICULTURE.

THE following is the (second year's *) account of the produce of milk and Butter from a cow, the property of William Cramp, of Lewes, in the county of Sussex, for this season, commencing the 19th day of April 1806 (that

* For an account of the first year's produce see our tenth volume of the present series, page 37.

being the day on which she calved) up to the 27th day of February 1807, a space of time of forty-five weeks.

BUTTER.	Number of Weeks.	Pounds per Week.	Quantity of Butter.	Sold at per Pound.		Total Value.	
				s. d.	£. s. d.	s. d.	£. s. d.
From the 19th of April to the 2d of May, gave no milk but what the calf sucked	2	—	—	—	—	—	—
From the 3d May to the 23d May ...	3	10	30	1 4	2 0 0	1 4	2 0 0
From the 24th May to the 6th June..	2	10½	21	1 4	1 8 0	1 4	1 8 0
From the 7th June to the 3d Oct.	17	12	204	1 5	14 9 0	1 5	14 9 0
From the 4th Oct. to the 12th Dec. ..	10	10½	105	1 6	7 17 6	1 6	7 17 6
From the 13th Dec. to the 6th Feb. 1807	8	9	72	1 6	5 3 0	1 6	5 3 0
From the 7th Feb. to the 27th Feb. left off milking	3	6	18	1 6	1 7 0	1 6	1 7 0
	45		450		32 9 6		32 9 6

MILK.

	Quarts.	Quarts.
From the 3d May to the 23d May 12 <i>per day</i>	252	
From the 24th May to the 6th June 14	196	
From the 7th June to the 3d October.... 16	1904	
		From

of Milk and Butter from one Cow. 387

	Quarts.	Quarts.
Brought forward	42	per day 2352
From the 4th October to the 12th Dec. 14	—	980
From the 13th Dec. to the 6th Feb.	11	— 616
From the 7th Feb. to the 27th Feb.	9	— 189
		4137

The milk being measured when milked from the cow, there must be deducted for cream	450
	3687

	£.	s.	d.
3687 quarts of skim milk, at 1 <i>d.</i> per quart	15	7	3
Sold the calf for	1	10	0
Value of manure, four large waggon loads	3	0	0
	52	6	9
Total expense	21	10	8

Profit 30 16 1

EXPENSE.

The same as in my last year's return	21	6	2
* An additional expense for farriering	0	4	6
	21	10	8

* Having been taken ill with the yellows at the time of her calving, she required the assistance of a farrier for three weeks. The complaint fell into the udder, and was (no doubt) the cause of her not giving so great a quantity of milk as she did the season before. This complaint was very general amongst milch cows that spring in this neighbourhood; many cows totally lost their milk, and some died of the disease. I have stated this, because many persons have asserted I ruined my cow's constitution by milking her so long; and that she would never be the same again. The produce of milk was not so much as last season; but I have no doubt that was in consequence of the complaint, and not from any other cause whatever. The produce of butter this season proves her milk to have been equally as rich as it was the former season; the quantity of butter being in proportion to the quantity of milk. It will be observed, that the first fortnight she gave no more milk but what the calf sucked; and that she was not milked so long, by three weeks and one day, as she was the former season.

D d d 2

Improved

*Improved Tram-Plates for Carriages on Rail Roads.
Invented by Mr. CHARLES LE CAAN, of Llanelly, in Wales.*

With an Engraving.

From the TRANSACTIONS of the SOCIETY for the Encouragement of ARTS, MANUFACTURES, and COMMERCE.

*Twenty Guineas were voted by the Society for this
Communication.*

I HAVE forwarded to the Society of Arts, &c. a specimen of my new method of laying rails, or tram-plates, on such a plan as has met the entire approbation of those who have seen it, and are acquainted with the principle on which such roads should be formed. Rail roads are daily increasing, from the great advantage they afford to those manufactories connected with mines and minerals, particularly to collieries. They also promote agriculture, by occasioning lime to be procured from places almost inaccessible by any other means, or from whence it could not be otherwise brought on moderate terms.

I flatter myself that every improvement on this system will be of national importance. The honour I received last year from the Society of Arts, &c. has stimulated me to submit the present subject to their consideration.

I have also sent a drawing of my method of laying the tram-plates, with an estimate of the saving that will arise to the public, by adopting the said method, with necessary remarks on the principle on which it is founded. The leading rail or tram-plate has neither tenon or mortise over the plug. The stop-plate terminates the specimen, which stop-plate should go in with some degree of tightness when laid for actual use, but in the present case that force is not necessary, as the
wooden

wooden blocks by a carriage of upwards of 200 miles, may in some small degree be misplaced. I hope any impediment of that nature will be rectified or allowed for. I wish it to be understood, that a stop-rail is intended to be placed at every 30 yards, at which distance any repairs may be made within ten minutes, which by the present mode frequently occupies more than twice that time, exclusive of disturbing in some measure the line of road. By my method, the plate has a certain degree of play, which is absolutely necessary to avoid that breakage which too frequently takes place when they are fixed with nails and plugs.

The plates which I send have been fixed in stone blocks, and are nearly as rough as when taken from the sand. If I am favoured with any mark of the Society's approbation, I shall hold myself bound to transmit such further communications on this subject as may be required by them, or any person desirous of adopting my plan.

The following Letters of Approbation were also communicated to the Society.

Sir,

I have considered the improvement made by you in the specimen exhibited of a new design of a tram-plate, and am of opinion that much advantage may be derived to tram roads by the adoption of your plan in preventing the temptation of stealing the wrought-iron nails, with which the plates are usually fastened, and by facilitating the operation of laying down new tram roads, and repairing of old ones.

I am, Sir, your most humble servant,

Llangennech Park, April 2d, 1806.

J. VANCOUVER.

To. Mr. Le Caan.

Sir,

so that the shoulder of the plug may not receive any sharp pressure or prevent the plate from having a perfect bearing. There is a small groove in the whole length of the exterior of each plug, to admit a wire to pass to its extremity, to draw the plug out if broken by any accident, also to admit the expansion of water, in case of severe frost.

The blocks or sleepers EFG, on which the tram-plates are placed, should by no means be less than 120 pounds each in weight, but should be heavier on some kinds of ground: the depth of the hole for the plug should be three inches, and worked according to the inclination of the plug, for which purpose the stonemason should have a standard cast-iron gauge; there should be projections, K, cast with the flanch or outside edge of the tram-plate, as shewn at Fig. 13, to make the plates lie firm on their sleepers.

Fig. 16 is a section of one of the ends of a tram-plate, in which H shews the flanch or upright edge, I the flat part or sole on which the wheels of the yaggons run, D one of the plugs, K the projection behind the flanch to make the plate lie firm on the blocks.

GENERAL OBSERVATIONS.

The advantages of laying plates on the above principle is obvious; the blocks being put in their places never sink below their intended level, the act of driving either nail or plug (which requires a considerable degree of force, and too frequently destroys the level of the road) being here unnecessary. In the common mode of making rail-roads, from the irregularity of nails, particularly

cularly in forming their heads, few can be driven exactly even with the plate, and are perpetually obstructing the passage of the waggon; the workmen frequently not proportioning their holes and plugs to the hole in the block also occasions considerable breakage; the exertion necessary to fix a rail or plate completely is great, and numbers of plates, particularly when the iron is short or brittle, are broken near the mortises by missing the stroke of the hammer, which must be used with great force.

Advantage gained in laying my Tram-plates in comparison with other Modes.

	£.	s.	d.
Nails used in a mile, 3520 of 3 in the pound,			
at 4d. per lb. - - - - -	19	11	0
Nails lost or defective, computed at per mile	1	0	0
Plugs with their loss - - - - -	6	5	0
By breakage of rails, average from experience	7	10	0
Lessened by labour in block laying, calculated at only two-pence per yard - -	14	13	4
By breakage of blocks - - - - -	1	0	0
	£. 49	19	4

This calculation does not take in annual loss of nails, and breakage of blocks, which is considerable.

On Oxalic Acid.

By THOMAS THOMSON, M. D. F. R. S. Ed.

(Concluded from page 354.)

6. I SHALL now detail one of my experiments more particularly. Eighty-nine grains of well-dried oxalate of lime were exposed in a small retort to a heat gradually raised to redness; the products were the following:

	Grains.
45.6 cubic inches of gas * weighing	14.8
Water	6.4
Residue in retort	62.4
	83.6
Loss	5.4
Total	89.0

The loss is obviously owing to the gas which filled the retort and tube when the experiment was concluded. We are warranted therefore to add it to the weight of the gaseous products obtained.

Now the gas was composed of

	Grains.
Carbonic acid 10.5 cubic inches =	4.9
Inflammable air....35.1	= 9.9

so that one-third of the weight was carbonic acid and two-thirds inflammable air. If we divide the 5.4 grains of loss, in that proportion we obtain 1.8 grains carbonic acid, and 3.6 grains of inflammable air. Adding these quantities to the weight obtained, we get for the weight of the whole gaseous product

* The gas obtained measured 60 cubic inches, but 14.4 inches of these were found to be common air which had previously filled the retort and tube; this quantity was therefore deducted.

Carbonic

	Grains.
Carbonic acid	6.7
Inflammable air	13.5
	20.2

The 62.4 grains of residue in the retort were composed of

	Grains.
Lime	33.4
Carbonic acid	26.4
Charcoal	2.6
	62.4

Now it is clear, that the 89 grains of oxalate of lime were composed of

Lime	33.4
Acid	55.6
	89.0

The acid was completely decomposed and resolved into the following products :

Carbonic acid	33.1
Inflammable air	13.5
Water	6.4
Charcoal	2.6
	55.6

Had the experiment been made upon 100 grains of oxalic acid instead of 55.6, it is clear that the proportions would have been as follows :

Carbonic acid	59.53
Inflammable air	24.28
Water	11.51
Charcoal	4.68
	100.00

The most remarkable circumstance attending the decomposition of oxalic acid by heat, is the great proportion of carbonic acid formed; the quantity amounts to 6-10ths of the whole weight of acid decomposed.

As the composition of all these products of oxalic acid is known with considerable accuracy, it is obvious that they furnish us with the means of ascertaining the constituents of that acid itself.

59.53 grains of carbonic acid are composed of

	Grains.
Oxygen	42.86
Carbon	16.67
	59.53

24.28 grains of inflammable air, according to the analysis given in a preceding part of this paper, are composed of

	Grains.
Oxygen	11.96
Carbon	10.43
Hydrogen	1.89
	24.28

11.51 grains of water are composed of

Oxygen	9.87
Hydrogen	1.64
	11.51

As for the charcoal, though it probably contains both oxygen and hydrogen as well as carbon, yet as the proportion of the two first ingredients is probably very small, and as we have no means of estimating them, we must at present rest satisfied with considering it as composed of pure carbon.

When

When these different elements are collected under their proper heads, we obtain

1. Oxygen in carbonic acid	42.86
—— inflammable air	11.96
—— water	9.87

64.69

2. Carbon in carbonic acid	16.67
—— inflammable air	10.43
—— charcoal	4.68

31.78

3. Hydrogen in inflammable air	1.89
—— water	1.64

3.53

Hence oxalic acid is composed of oxygen 64.69

—— carbon 31.78

—— hydrogen .. 3.53

100.00

7. The result of two other experiments on oxalate of lime was very nearly the same as the preceding: The following may be stated in round numbers as the mean of the whole. Oxalic acid is a compound of

Oxygen 64

Carbon 32

Hydrogen 4

100

8. The only other analysis of oxalic acid with which I am acquainted has been given by M. Fourcroy, as the result of his own experiments, in conjunction with those of Vauquelin *. It is as follows:

* Systeme de Connois Chem, vol. VII. p. 224.

Oxygen

Oxygen	77
Carbon	13
Hydrogen	10

 100

It gave me considerable uneasiness to observe, that my experiments led to conclusions irreconcilable with those of chemists of such eminence and consummate skill, and it was not without considerable hesitation that I ventured to place any reliance upon them. I am persuaded, however, that some mistake has inadvertently insinuated itself into their calculations; since the carbonic acid alone, formed during the distillation of oxalate of lime, contains considerably more carbon than the whole quantity which they assign to the oxalic acid decomposed. M. Fourcroy informs us, that oxalic acid is converted into carbonic acid and water, when acted upon by hot nitric acid; and this decomposition seems to have been the method employed, to ascertain the proportion of the constituents of oxalic acid; but the numbers assigned by him do not correspond with this statement. For 10 parts of hydrogen require 60 of oxygen to convert them into water, and 13 of carbon require at least 33 of oxygen. So that instead of 77 parts of oxygen, there would have been required no less than 98 to convert the hydrogen and carbon into water and carbonic acid. It is true, that the surplus of oxygen may be conceived to be furnished by the nitric acid; but if this be admitted (and I have no doubt, from experience, that the nitric acid actually does communicate oxygen), it is difficult to see how the constituents of oxalic acid could be determined by any such decomposition, unless the quantity of oxygen furnished by the nitric acid were accurately ascertained.

IV. *Composition of Oxalic Acid.*

The knowledge of the relative weights of the elements which compose oxalic acid, though of importance, is not sufficient to convey a clear idea of this compound, and in what respect it differs from tartaric acid, alcohol, sugar, and various other bodies possessing very different properties, though composed of the very same elements in different proportions.

It has been ascertained, by numerous and decisive experiments, that elementary bodies always enter into combinations in determinate proportions, which may be represented by numbers. For example, the numbers which correspond to the four elements, oxygen, azote, carbon, and hydrogen, are the following :

Oxygen	6
Azote	5
Carbon	4.5
Hydrogen	1

Now, in all compounds consisting of these ingredients, the proportion of the different constituents may always be represented by these numbers, or by multiples of them ; thus, the composition of the following substances may be thus stated.

	Oxygen.	Hydrogen.	Carbon.	Azote.
Water	6	+ 1		
Carbonic oxyd	6		+ 4.5	
Carbonic acid	2 × 6		+ 4.5	
Carbureted hydrogen		2 × 1	+ 4.5	
Olefiant gas		1	+ 4.5	
Nitrous gas	6			+ 5
Nitric acid	2 × 6			+ 5
Nitrous oxyd	6			+ 2 × 5
				From

From the knowledge of this curious law, it is difficult to avoid concluding that each of these elements consist of atoms of determinate weight, which combine according to certain fixed proportions, and that the numbers above given represent the relative weights of these atoms respectively. Thus, an atom of oxygen weighs six, an atom of hydrogen one, &c. Water is composed of one atom of oxygen and one atom of hydrogen; carbonic acid of two atoms of oxygen and one of carbon, &c. This curious theory, which promises to throw an unexpected light on the obscurest parts of chemistry, belongs to Mr. Dalton. I have elsewhere illustrated it at considerable length*.

The same law holds with respect to the salts. The acid and bases always combine in determinate proportions. We may affix numbers to all the acids and bases, which numbers, or their multiples, will represent all the combinations into which these bodies enter. Some of these numbers are given in the following table :

Sulphuric acid	33	Barytes	67
Muriatic acid	18	Soda	24
Carbonic acid	16.5	Lime	23
Nitric acid	17	Ammonia	6

These numbers may be conceived to represent the relative weights of an integrant particle of each of these substances; formed on the supposition that an atom of hydrogen weighs 1. It follows equally from this law, that the acids and bases combine particle with particle, or a certain determinate number of particles of the one with a particle of the other.

* See System of Chemistry, vol. III. p. 424, &c. third Edit.

One of the most important points in the investigation of compound bodies, is to ascertain the number which denotes the weight of an integrant particle of each of them, that of an atom of hydrogen being 1; because this number, or a multiple of it, represents the weight of each, which enters into all combinations, and because it enables us to estimate the number of elementary atoms of which each is composed. From a careful comparison of the table of oxalates, given in a preceding part of this paper, with the weight of the different bases already determined *, it appears that the weight of an integrant particle of oxalic acid must be represented by the number 39.5.

Now, what number of atoms of oxygen, carbon, and hydrogen, go to constitute an integrant particle of oxalic acid? We have assigned the relative weights of each of these atoms, and we have ascertained the relative proportions of the respective elements of oxalic acid. From these data it is easy to solve the problem. An integrant particle of oxalic acid consists of 9 atoms combined together, namely 4 atoms of oxygen, 3 of carbon, and 2 of hydrogen.

4 atoms of oxygen weigh	4×6	$= 24$
3 atoms of carbon	3×4.5	$= 13.5$
2 atoms of hydrogen	2×1	$= 2$
Total		39.5

* For these weights, and the method of determining them, I refer the reader to my *System of Chemistry*, third Edit. vol. III. p. 619. The numbers which I have there assigned are, I am persuaded, rather too low.

which together make up the weight of an integrant particle of oxalic acid.

According to these proportions, 100 parts of oxalic acid is composed of

Oxygen	61
Carbon	34
Hydrogen	5
	100

numbers which do not indeed exactly correspond with the result of the preceding analysis, but which approach sufficiently near it to give the reasoning employed considerable probability at least, if it does not lead to certainty.

We may now examine the decomposition which takes place when oxalate of lime is exposed to heat. Let an atom of oxygen be w , an atom of carbon c , and an atom of hydrogen h . An integrant particle of oxalic acid may be represented by $4w + 3c + 2h$. We may represent the composition and weight of an integrant particle of each of the substances into which oxalic acid is decomposed by heat, by the following symbols and numbers :

Carbonic acid	$2w + c$	weight 16.5
Carbureted hydrogen	$c + 2h$	6.5
Carbonic oxyd	$w + c$	10.5
Water	$w + h$	7
Charcoal	c	4.5

We may now conceive 3 particles of oxalic acid to be decomposed at once, and to resolve themselves into these substances, in the following proportions :

4 particles

4 particles of carbonic acid	$= 8 w + 4 c$
2 ————— carbureted hydrogen = ...	$2 c + 4 h$
2 ————— carbonic oxyd	$= 2 w + 2 c$
2 ————— water	$= 2 w + 2 h$
1 ————— charcoal	$= 1 c$

Total $12 w + 9 c + 6 h$

3 ————— oxalic acid $= 12 w + 9 c + 6 h$

We see that such a decomposition is possible. It remains only therefore to see whether the weights of these substances, which result from this hypothesis, correspond with the preceding analysis. Now,

4 particles of carbonic acid weigh ...	$4 \times 16.5 = 66$
2 ————— carbureted hydrogen ..	$2 \times 6.5 = 13$
2 ————— carbonic acid	$2 \times 10.5 = 21$
2 ————— water	$2 \times 7 = 14$
1 ————— charcoal	$4.5 = 4.5$

Total 118.5

Reducing these proportions to 100 parts of acid, and joining together the two inflammable gases, the numbers come out as follows :

Carbonic acid	55.70	we actually obtained	59.53
Inflammable air	28.69		24.28
Water	11.81		11.51
Charcoal	3.80		4.68
	100.00		100.00

It is impossible to expect exact correspondence between the theory and hypothesis, till the numbers representing the weights of the elementary atoms be ascertained with more rigid accuracy than has hitherto been done. I satisfied myself with taking the nearest round

F f f 2 numbers,

numbers, which are sufficient at least to show an evident approximation to the proportions obtained by experiment.

V. Composition of Sugar, and Formation of Oxalic Acid.

When a compound body is decomposed, and resolved into a number of new substances, the products are almost always simpler, or consist of integrant particles, composed of fewer atoms than the integrant particles of the original body. Thus, though oxalic acid is composed of 9 atoms, none of the products evolved, when that acid is decomposed by heat, contain more than 3 atoms. Hence it is probable that sugar is a more compound body than oxalic acid, because nitric acid resolves it into a variety of new compounds, one of which is oxalic acid. It may be worth while to examine the action of nitric acid on sugar, and the formation of oxalic acid, more closely than has hitherto been done, as the investigation will furnish some data for estimating the composition of sugar.

Two hundred grains of pure crystallised sugar being treated with diluted nitric acid in the usual way, yielded 200 cubic inches of carbonic acid, 64 cubic inches of nitrous gas, and 70 cubic inches of azotic gas. But these numbers, though the result of a good many experiments, are not to be considered as very exact. The uncertainty depends upon the property which the solution has of producing more gas after the sugar is decomposed, at the expense of the oxalic acid formed. Now, it is difficult to stop at the precise point.

The whole weight of oxalic acid, which can be obtained from 200 grains of sugar, amounts to 116 grains. If the experiment be properly conducted, the whole of the sugar is decomposed, or at least the quantity of residuary matter is small.

From

From the preceding statement, there is reason to conclude that 100 grains of sugar, when decomposed by nitric acid, yield,

Grains.

1. Oxalic acid crystals 58 grains, or real acid 45
 2. Carbonic acid 100 cubic inches, equivalent to 46.5
- while these are evolved obviously by the decomposition of the nitric acid.

Grains.

1. Azotic gas 35 cubic inches equivalent to 10.62
2. Nitrous gas 32 cubic inches equivalent to ... 10.85

Now, as nitric acid contains no carbon, it is obvious that the oxalic acid formed, and the carbonic acid evolved, must contain the whole carbon contained in 100 grains of sugar.

Grains.

45 grains of oxalic acid contain of carbon 14.40
 46.5 grains of carbonic acid contain of ditto .. 13.02

Total 27.42

therefore 100 grains of sugar contain $27\frac{1}{2}$ grains of carbon.

The azotic gas and nitrous gas must have been originally in the state of nitric acid, and must have given out oxygen when they were evolved. But nitric acid is composed of

Oxygen.

Azote 10.62 + 25
 Nitrous gas 10.85 + 4.5

29.5

Therefore they must have parted with 29.5 grains of oxygen. We are at liberty to suppose that the whole of this oxygen went to the formation of carbonic acid. Now, 46.5 grains of carbonic acid are composed of

Oxygen

	Grains.
Oxygen	38.5
Carbon	13.0
	46.5

From this it appears, that in the carbonic acid there were 4 grains of oxygen more than was furnished by the nitric acid. I confess I am disposed to ascribe this surplus to errors in the experiments, and to believe that the whole of the oxygen of the carbonic acid was furnished by the nitric acid. This being admitted, it follows that the carbon of the carbonic acid, and the whole constituents in the oxalic acid, were furnished by the sugar. These are as follows :

	Grains.
Carbon	27.5
Oxygen in 45 grains oxalic acid	28.8
Hydrogen in ditto	1.8
	58.1

If this total be subtracted from the 100 grains of sugar used, there will be a remainder of 41.9 grains. As this quantity of the sugar has disappeared, and is no where to be found among the products, we must suppose that it has assumed the form of water. Now 41.9 grains of water are composed of

Oxygen	35.9
Hydrogen	6
	41.9

Adding these quantities to the preceding products, we obtain the composition of sugar, as follows :

Oxygen	64.7
Carbon	27.5
Hydrogen	7.8
	100.0

Though.

Though the process of reasoning, which led to this analysis of sugar, is too hypothetical to be trusted implicitly, yet I am persuaded that it is to a certain degree correct, and that the result obtained does not deviate very far from the truth. If we compare Lavoisier's statement of the composition of sugar obtained in a different manner, though by a mode of reasoning not less hypothetical, we shall be surprised at its near coincidence with mine. His numbers are,

Oxygen	64
Carbon	28
Hydrogen	8

100

It is true that two different hypotheses may lead to the same result, and yet be both wrong; but this becomes infinitely improbable in the present case, when we consider that the proportion of carbon, which I assign to sugar, must at all events be nearly correct.

We have no direct method of determining the weight of an integrant particle of sugar; but if the accuracy of the preceding analysis be admitted, it furnishes us with an indirect one, which cannot be rejected; for it is clear, that the atoms of oxygen, carbon, and hydrogen, will be to each other respectively, as the numbers $\frac{8}{3}$, $\frac{4}{3}$, $\frac{1}{3}$; and these numbers reduced to their lowest terms become 5, 3, 4, nearly, which being primes with respect to each other, must represent the number of atoms, of which an integrant particle of sugar is composed. Sugar then is a compound of 12 atoms; namely, five of oxygen, three of carbon, and four of hydrogen; the weight of an integrant particle of it is 47.5, and its symbol is $5\ o + 3\ c + 4\ h$. It differs from oxalic acid merely

merely in containing an additional atom of oxygen and two of hydrogen. If we had any method of removing these substances, without altering the proportion of the other constituents, we should obtain a much greater quantity of oxalic acid from sugar than we can at present; but nitric acid acts by removing one-half of the carbon in the form of carbonic acid; the sugar deprived of this, resolves itself into oxalic acid and water. Suppose two particles of sugar acted on at once, the symbol for them will be $10w + 6c + 8h$. Let three atoms of the carbon be removed by the action of the nitric acid, there will remain $10w + 3c + 8h$. Now

A particle of oxalic acid = $4w + 3c + 2h$

Six particles of water = $6w$ + $6h$

$$10w + 3c + 8h$$

which is just the quantity of oxalic acid left. This will give us some idea of the way in which the formation of oxalic acid by nitric acid is accomplished. And although the series of changes is probably more complicated, yet they are ultimately equivalent to the preceding statement. I allude to the formation of malic acid, which is said to precede the oxalic acid, and afterwards to be converted into it by the subsequent action of nitric acid; but on the composition and formation of this latter acid, I avoid making any observations at present, as I propose to make them the subject of a separate dissertation.

*On Super-acid and Sub-acid Salts.**By WILLIAM HYDE WOLLASTON, M. D. Sec. R. S.*

IN the paper which has just been read to the Society, Dr. Thomson has remarked, that oxalic acid unites to strontian as well as to potash in two different proportions, and that the quantity of acid combined with each of these bases in their super-oxalates, is just double of that which is saturated by the same quantity of base in their neutral compounds.

As I had observed the same law to prevail in various other instances of super-acid and sub-acid salts, I thought it not unlikely that this law might obtain generally in such compounds, and it was my design to have pursued the subject with the hope of discovering the cause to which so regular a relation might be ascribed.

But since the publication of Mr. Dalton's theory of chemical combination, as explained and illustrated by Dr. Thomson *, the inquiry which I had designed appears to be superfluous, as all the facts that I had observed are but particular instances of the more general observation of Mr. Dalton, that in all cases the simple elements of bodies are disposed to unite atom to atom singly, or, if either is in excess, it exceeds by a ratio to be expressed by some simple multiple of the number of its atoms.

However, since those who are desirous of ascertaining the justness of this observation by experiment, may be deterred by the difficulties that we meet with in attempting to determine with precision the constitution of gaseous bodies, for the explanation of which Mr. Dalton's

* Thomson's Chemistry, third Edit. vol. III. p. 425.

theory was first conceived, and since some persons may imagine that the results of former experiments on such bodies do not accord sufficiently to authorize the adoption of a new hypothesis, it may be worth while to describe a few experiments, each of which may be performed with the utmost facility, and each of which affords the most direct proof of the proportional redundancy or deficiency of acid in the several salts employed.

Sub-carbonate of Potash.

Exp. 1. Sub-carbonate of potash recently prepared, is one instance of an alkali having one-half the quantity of acid necessary for its saturation, as may thus be satisfactorily proved.

Let two grains of fully saturated and well crystallized carbonate of potash be wrapped in a piece of thin paper, and passed up into an inverted tube filled with mercury, and let the gas be extricated from it by a sufficient quantity of muriatic acid, so that the space it occupies may be marked upon the tube.

Next, let four grains of the same carbonate be exposed for a short time to a red heat; and it will be found to have parted with exactly half its gas; for the gas extricated from it in the same apparatus will be found to occupy exactly the same space, as the quantity before obtained from two grains of fully saturated carbonate.

Sub-carbonate of Soda.

Exp. 2. A similar experiment may be made with a saturated carbonate of soda, and with the same result; for this also becomes a true semi-carbonate by being exposed for a short time to a red heat.

Super-

Super-sulphate of Potash.

By an experiment equally simple, super-sulphate of potash may be shewn to contain exactly twice as much acid as is necessary for the mere saturation of the alkali present.

Exp. 3. Let twenty grains of carbonate of potash (which would be more than neutralized by ten grains of sulphuric acid) be mixed with about twenty-five grains of that acid in a covered crucible of platina, or in a glass tube three quarters of an inch diameter, and five or six inches long.

By heating this mixture till it ceases to boil, and begins to appear slightly red hot, a part of the redundant acid will be expelled, and there will remain a determinate quantity forming super-sulphate of potash, which when dissolved in water will be very nearly neutralized by an addition of twenty grains more of the same carbonate of potash; but it is generally found very slightly acid, in consequence of the small quantity of sulphuric acid which remains in the vessel in a gaseous state at a red heat.

In the preceding experiments, the acids are made to assume a determinate proportion to their base, by heat which cannot destroy them. In those which follow, the proportion which a destructible acid shall assume cannot be regulated by the same means; but the constitution of its compounds previously formed, may nevertheless be proved with equal facility.

Super-oxalate of Potash.

Exp. 4. The common super-oxalate of potash is a salt that contains alkali sufficient to saturate exactly half of

the acid present. Hence, if two equal quantities of salt of sorrel be taken, and if one of them be exposed to a red heat, the alkali which remains will be found exactly to saturate the redundant acid of the other portion.

In addition to the preceding compounds, selected as distinct examples of binacid salts, I have observed one remarkable instance of a more extended and general prevalence of the law under consideration; for when the circumstances are such as to admit the union of a further quantity of oxalic acid with potash, I found a proportion, though different, yet analogous to the former, regularly to occur.

§. Quadroxalate of Potash.

In attempting to decompose the preceding superoxalate by means of acids, it appeared that nitric or muriatic acids are capable of taking only half the alkali, and that the salt which crystallizes after solution in either of these acids, has accordingly exactly four times as much acid as would saturate the alkali that remains.

Exp. 5. For the purpose of proving that the constitution of this compound has been rightly ascertained, the salt thus formed should be purified by a second crystallization in distilled water; after which the alkali of thirty grains must be obtained by exposure to a red heat, in order to neutralize the redundant acid contained in ten grains of the same salt. The quantity of unburned salt contains alkali for one part out of four of the acid present, and it requires the alkali of three equal quantities of the same salt to saturate the three remaining parts of acid.

The

The limit to the decomposition of super-oxalate of potash by the above acids, is analogous to that which occurs when sulphate of potash is decomposed by nitric acid; for in this case also, no quantity of that acid can take more than half the potash, and the remaining salt is converted into a definite super-sulphate, similar to that obtained by heat in the third experiment.

It is not improbable that many other changes in chemistry, supposed to be influenced by a general redundancy of some one ingredient, may in fact be limited by a new order of affinities taking place at some definite proportion to be expressed by a simple multiple. And though the strong power of crystallizing in oxalic acid renders the modifications of which its combinations are susceptible more distinct than those of other acids, it seems probable that a similar play of affinities will arise in solution, when other acids exceed their base in the same proportion.

In order to determine whether oxalic acid is capable of uniting to potash in a proportion intermediate between the double and quadruple quantity of acid, I neutralized forty-eight grains of carbonate of potash with thirty grains of oxalic acid, and added sixty grains more of acid, so that I had two parts of potash of twenty-four grains each, and six *equivalent* quantities of oxalic acid of fifteen grains each, in solution, ready to crystallize together, if disposed to unite, in the proportion of three to one; but the first portion of salt that crystallized, was the common binoxalate, or salt of sorrel, and a portion selected from the after crystals (which differed very discernibly in their form) was found to contain the quadruple proportion of acid. Hence it is to be presumed, that if these salts could have been perfectly separated,

separated, it would have been found, that the two quantities of potash were equally divided, and combined in one instance with two, and in the other with the remaining four out of the six *equivalent* quantities of acid taken.

To account for this want of disposition to unite in the proportion of three to one by Mr. Dalton's theory, I apprehend he might consider the neutral salt as consisting of

2 particles potash with 1 acid,

The binoxalate as 1 and 1, or 2 with 2

The quadroxalate as 1 and 2, or 2 with 4

in which cases the ratios which I have observed of the acids to each other in these salts would respectively obtain.

But an explanation, which admits the supposition of a double share of potash in the neutral salt, is not altogether satisfactory; and I am further inclined to think, that when our views are sufficiently extended, to enable us to reason with precision concerning the proportions of elementary atoms, we shall find the arithmetical relation alone will not be sufficient to explain their mutual action, and that we shall be obliged to acquire a geometrical conception of their relative arrangement in all the three dimensions of solid extension.

For instance, if we suppose the limit to the approach of particles to be the same in all directions, and hence their virtual extent to be spherical (which is the most simple hypothesis); in this case, when different sorts combine singly there is but one mode of union. If they unite in the proportion of two to one, the two particles will naturally arrange themselves at opposite poles of that to which they unite. If there be three, they might be

be arranged with regularity, at the angles of an equilateral triangle in a great circle surrounding the single spherule; but in this arrangement, for want of similar matter at the poles of this circle, the equilibrium would be unstable, and would be liable to be deranged by the slightest force of adjacent combinations; but when the number of one set of particles exceeds in the proportion of four to one, then, on the contrary, a stable equilibrium may again take place, if the four particles are situated at the angles of the four equilateral triangles composing a regular tetrahedron.

But as this geometrical arrangement of the primary elements of matter is altogether conjectural, and must rely for its confirmation or rejection upon future inquiry, I am desirous that it should not be confounded with the results of the facts and observations related above, which are sufficiently distinct and satisfactory with respect to the existence of the law of simple multiples. It is perhaps too much to hope, that the geometrical arrangement of primary particles will ever be perfectly known; since even admitting that a very small number of these atoms combining together would have a tendency to arrange themselves in the manner I have imagined; yet, until it is ascertained how small a proportion the primary particles themselves bear to the interval between them, it may be supposed that surrounding combinations, although themselves analogous, might disturb that arrangement, and in that case, the effect of such interference must also be taken into the account, before any theory of chemical combination can be rendered complete.

List of Patents for Inventions, &c.

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JOHN WARREN, of the town and county of the town of Poole, Stone-mason; for an apparatus to prevent chimneys from smoking, and to extinguish fires in grates and stoves without making any dust or smoke injurious to the room or furniture. Dated September 15, 1808. Specification to be enrolled within one month.

EDWARD MASSEY, of Newcastle, in the county of Stafford, Clock and Watchmaker; for an improved cock for drawing off liquors. Dated September 24, 1808. Specification to be enrolled within one month.

THOMAS PATON, of the parish of Christ Church, in the county of Surrey, Engineer; for an improved wheel for various useful purposes. Dated September 24, 1808. Specification to be enrolled within one month.

SEBASTIAN ERARD, of Great Marlborough-street, in the county of Middlesex; for certain improvements upon piano fortes, large and small, and upon harps, for which harps he has already obtained letters patent. Dated September 24, 1808. Specification to be enrolled within six months.

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